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JULY/AUGUST 2005

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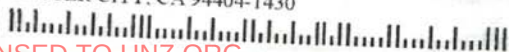
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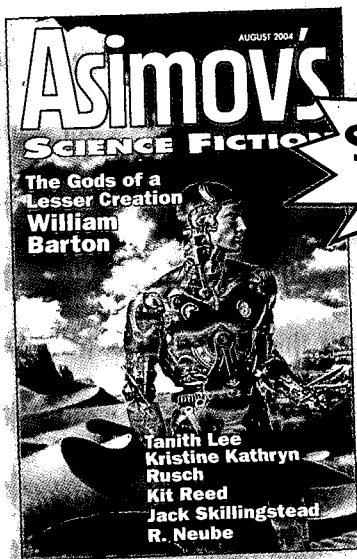
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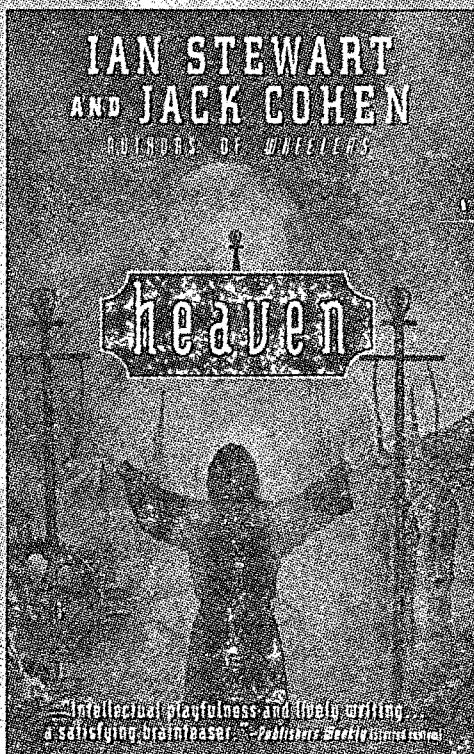
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SCIENCE FICTION AND FACT

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July/August 2005

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INEVITABLE CLICHÉS

When is a phrase or an idea a cliché? Dictionaries define such as "trite or overused," but sometimes things get heavily used for a reason: they're frequently useful and no better substitute is available.

The Readers' Forum on the *Analog* website recently had a prolonged and lively discussion of this question with particular reference to science fiction. It established near the outset that there is a distinction between overuse of expressions and of ideas, but there is also a connection between the two. Someone pointed out that references to "star-studded skies" are pretty much inevitable if you have many stories with scenes set on worlds with reasonably clear atmospheres and astronomical situations that give them day and night, because star-studded skies will be routinely visible on such worlds. Author Mike Flynn agreed that they will, but added that there are many possible ways to describe them and that part of the art of writing is finding original and interesting ones.

He's right, of course (as he demonstrated on the spot with several fine examples), but the number of ways of talking about them is not infinite. In less skillful hands, the constant and almost desperate seeking after novel ways to express such a basic concept can itself become tiresome. Think of a typical sportscaster reciting a list of scores; the effort to come up with a different synonym for "beat" for every one, comes to seem, if you stop to think about it, com-

ical, painful, or both. It used to be fashionable for fiction writers to try to say almost anything ("queried," "replied," "declared," "expostulated" . . .) rather than "said" on the many occasions when a character says something. I'm told there were actually books of synonyms for "said," which some writers used to avoid the dreaded s-word. Eventually reaction set in, and many excellent writers now deride those synonyms as "said-bookisms" and consider "said" (or nothing) to be almost always the best choice, unless particular circumstances dictate a clear need for something else. The obsession with avoiding "said" at all costs had become a cliché in its own right.

How about ideas themselves? Can the very concepts at the heart of science fiction, and not just the words chosen to talk about them, become clichés best avoided? At first glance, it might seem that I would have to say yes. I once wrote an article called "The Ideas That Wouldn't Die," in which I listed 26 of them. More precisely, I listed 26 plot types that had been overworked to the point where I see them several times a year (or even month) among the story submissions I receive for *Analog*. I seldom buy such stories because they're usually too much like things I've read too many times before. But I also mentioned in that article that virtually any of those ideas can be, and rarely is, still turned into a fresh story by a skillful writer who thinks of something new to do with it. The problem is not that clone stories or psi stories or cryonics stories

or space stories should never be attempted again because they've been done before. The problem is rather that there's no point in doing again the specific things that have already been done with them, particularly if (as is often the case) the old ideas about them have since been shown to be wrong.

Indeed, in some of those areas we need new stories more than ever—provided they're genuinely new and solidly grounded in real and up-to-date science. Cloning, for example, has been the subject of an appalling number of appalling stories, often based on silly arguments about whether somebody is a clone or a “real person,” or regarding murder of a clone as suicide, because the writers didn't understand that a human clone is a distinct and real person with exactly the same genetic relationship to his or her original as an identical twin. We need no more of that nonsense, but we do need thoughtful explorations of what roles cloning might play in future societies—because we already know that it's real, and it isn't going to go away even if writers stop writing about it for fear of “clichés.”

A particularly interesting area that I've sometimes recently heard attacked as an outworn cliché is nanotechnology, which burst onto the scene in the mid-1980s, quickly captured the imagination of many science fiction writers and readers, and figured prominently in a great many stories. At this point I doubt that I

have to explain what it is or why it has attracted so much attention. If you're reading this, you're probably quite familiar with at least the general concept. It continues to play an important role in many new stories, and I've heard some readers complain that they've read enough about it and it's time to lay it to rest and move on to other things. Certainly it's time to consider new and different things; it's *always* time to do that in science fiction. But nanotechnology, like cloning, is probably a good example of something that can't just be dropped, even if quite a bit of attention is turned elsewhere.

Imagine yourself as a science fiction writer in the nineteenth and early twentieth centuries, when people like Michael Faraday, Joseph Henry, James Clerk Maxwell, Thomas Edison, Samuel F. B. Morse, Alexander Graham Bell, Thomas Edison, and Nikola Tesla were making fundamental breakthroughs in the understanding and application of electricity and magnetism. No doubt you would have incorporated speculations about extrapolations from their work into your stories. But should you have stopped doing so on the grounds that electricity and magnetism had become “clichés” once telephones and electric lights had appeared in a few dozen or a few hundred stories? You might have done so, had you listened to skeptics who dismissed telephones and electric lights as passing fads that would

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soon be forgotten. But if you had, you would have missed the boat quite dramatically as far as writing about anything resembling the real future is concerned. The wiser course, even if it got you laughed at or scorned by literary critics, would have been to take electricity and magnetism for granted as part of the background of virtually *every* story from then on out, and imagine the most advanced applications for them that you could.

Or consider computers, on which the whole field of science fiction largely *did* miss the boat. Sure, there were plenty of computers in science fiction; but with remarkably few exceptions, they were far bigger, clunkier, less powerful, and farther in the future than the ones we already have—and they're still evolving at high and constantly accelerating speed. John W. Campbell, my predecessor at *Analog* (then *Astounding*) who was famous for his expansive imagination and for revolutionizing the field of science fiction, published an article in 1939 in which author Leo Vernon imagined a "dream machine" that might exist sometime in the indefinite future. It occupied a whole building and required a whole team of specially trained mathematicians

to operate it. Campbell would probably have been astounded to hear that by 30 years after his death, and less than 70 after Vernon's article appeared, a far more powerful machine would sit on the desk of essentially any individual scientist or on the lap of many a commuting businessman. Or that second-graders would be using such machines to do schoolwork or play games, or that most of the millions of such machines in the world would be connected together in a vast network that would revolutionize how people live, learn, shop, and otherwise interact.

Would anybody seriously suggest that science fiction writers should stop writing about computers because "it's been done to death"? Hardly. Computers have become such a pervasive part of human culture that they simply cannot be ignored in any story that hopes to be taken seriously as an exploration of a possible future. And it's more important than ever to continue exploring how their continued development and proliferation will reshape human life.

Nanotechnology, I strongly suspect, is like that. As with electricity and computers, the time has long since passed when the mere novelty of its possibility

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could carry a story. So it is now less likely to appear as the central focus of a tale and more likely to be a taken-for-granted part of the background, just as electricity, telephones, and automobiles have been for many years. When it *is* the central focus, the theme will not be nanotechnology *per se*, as novelty, but rather the social and cultural impact of some new ramification that a writer has thought of and chosen to explore.

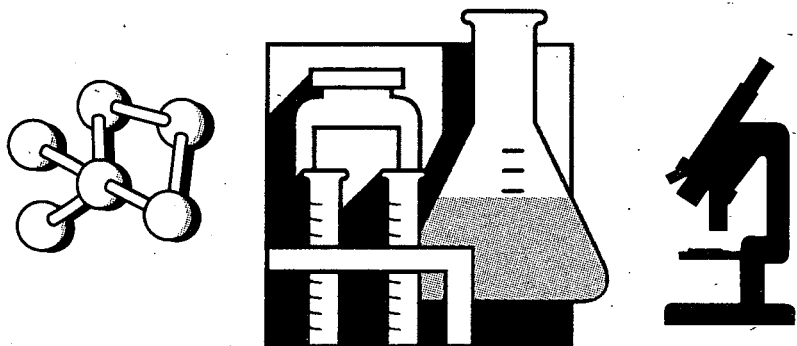
And, of course, the writer must play fair. Another complaint at least one forum participant had about nanotechnology in stories is that it seems too much like magic—that writers treat it as an unexplained way to do anything they would like a character to be able to do, without having to actually figure out how, or even whether it's really possible. The complaint has a certain limited validity; some writers do use it that way. But the fault there lies not with nanotechnology, but with sloppy world-building. Nanotechnology, if it develops as far as some think it might (and that question, at least, is still open), may indeed allow a great many things that now look to us like magic. But just like elec-

tricity and magnetism (which already allow many everyday things that would have looked like magic to our quite recent ancestors) it remains subject to well-defined physical laws. To write real science fiction rather than fantasy, authors must have some understanding of what the constraints are, and stay conscientiously within them. But then, that has always been true of solidly crafted science fiction based on any kind of science or technology.

I know at least one person who is both a science fiction writer and a professional scientist whose work has involved nanotechnology, who has gone so far as to say that any writer who *doesn't* include nanotechnology in his future story backgrounds has an obligation to justify the omission. To many people who have looked closely at it, it looks that inevitable. Categorically avoiding it as "clichéd" just isn't tenable anymore. Like electricity, magnetism, and space travel before it—and things I can't yet name that may come later—the trick is to incorporate it in ways that are simultaneously credible, original, and entertaining. ■

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THE ANALYTICAL LABORATORY



Thanks again to everyone who voted in our annual poll on the previous year's issues. Your votes help your favorite writers and artists by rewarding them directly and concretely for outstanding work. They help you by giving us a better feel for what you like and don't like—which helps us know what you'd like in the future.

We have five categories: novellas, novelettes, short stories, fact articles, and covers. In each category, we asked you to list your three favorite items, in descending order of preference. Each first place vote counts as three points, second place two, and third place one. The total number of points for each item is divided by the maximum it could have received (if everyone had ranked it 1) and multiplied by 10. The result is the score listed below, on a scale of 0 (nobody voted for it) to 10 (everybody ranked it first). In practice, scores run lower in categories with many entries than in those with only a few. For comparison, the number in parentheses at the head of each category is the score every item would have received had all been equally popular.

NOVELLAS (4.00)

1. "Layna's Mirror," Rajnar Vajra (5.47)
2. "Time Ablaze," Michael A. Burstein (4.07)
3. "Clay's Pride," Bud Sparhawk (3.42)
4. "Baby On Board," Kenneth Brady (3.17)
5. "To Emily On the Ecliptic," Thomas R. Dulski (2.43)

NOVELETTES (0.80)

1. "Short Line Loco," Stephen L. Burns (1.78)
2. "The Clapping Hands of God," Michael F. Flynn (1.74)
3. "Viewschool," Rajnar Vajra (1.47)
4. "PeriAndry's Quest," Stephen Baxter (1.43)
5. "Moreau²," Allen Steele (1.28)

SHORT STORIES (0.65)

1. "Shed Skin," Robert J. Sawyer (1.76)
2. "The Slow Train," Don Sakers (1.40)
3. "Dibs," Brian Plante (1.18)
4. "The Bambi Project," Grey Rollins (1.08)
5. "Gun Control," Edward Muller (1.04)

FACT ARTICLES (1.82)

1. "Open Minds, Open Source," Eric S. Raymond (2.91)
2. "Fat Mice, Eating Machines, and Biochemical Treason,"
Richard A. Lovett (2.48)
3. "The Fifth Biorevolution," Stephen L. Gillett (2.44)
4. "The Transience of Memory," Richard A. Lovett (1.97)
5. "Forensic Seismology: The Big Science of Minor Shake-Ups,"
Richard A. Lovett (1.62)

COVER (2.00)

1. November, by David A. Hardy (3.33)
2. (tie): October (for "Layna's Mirror"), by Bob Eggleton (2.39)
December, by Michael Carroll (2.39)
3. September, by David A. Hardy (2.21)
4. July/August (for *An Old-Fashioned Martian Girl*),
by Vincent Di Fate (2.02)

All categories had clear winners this year. The closest thing to a first-place tie was in novelettes, where Michael F. Flynn's "The Clapping Hands of God" placed only slightly behind Stephen L. Burns's "Short Line Loco." The only actual tie was for second place in covers, where David A. Hardy not only won but also snagged two of the next five slots. Richard A. Lovett competed even more strongly against himself in fact articles: no win, but three of the top five spots, with more total votes than any other author.

The number of votes was pretty good, but since AnLab votes are so useful to everyone concerned, we hope to get even more next time. Use e-mail or "snail mail," whichever you prefer, but please vote! (Please be careful to vote in the right category, as listed in the annual Index. Sometimes a few votes are wasted by being cast in the wrong category, and those simply can't be counted. If you didn't use the online voting on our website [www.analogsf.com] this year, you might want to try it next time; it makes that problem virtually impossible!)

Kay Slama, of Spicer, MN, is this year's winner of a free one-year subscription in a random drawing from all ballots received. Next year that could be you—and the more votes we have, the more the results mean!

Of Kings, Queens, and Angels

Rajnar Vajra

Folks who come from a *really* different place
may have really different ways—and wants.

Imagine, if you will, a cruise ship. Think *big*: half again the length of the QE3 and with every frill available to the latter twenty-first century. Imagine sybaritic cabins with cumulous beds, steaming aroma-chromotherapeutic swimming pools, and cuisine to make Brillat-Savarin drool in his grave.

Now try to imagine that this wonderliner, the *Mistral Majesty*, occupies an unfortunate position for any purely marine vessel: in midair almost two miles above an unearthly ocean, about to fall. . . .

Elija Cauless, Acting Captain, covertly swiped his damp palms across his immaculate white trousers.

"Ladies and gentlemen, we have the situation totally under control," he lied in a ship-wide broadcast. "Please remain calm."

He punched the PA's off-switch and rechecked the altimeter. Knowing

their precise elevation—to the inch!—only added a sour irony to his fear. A self-calibrating laser altimeter had always seemed absurd on a vessel designed to sail the high seas rather than the high skies.

True, the patrons had been promised "ADVENTURE'S PEAK IN LUXURY'S LAP" as the animated brochures proclaimed at ninety decibels to anyone slow to find the mute button. But this was surely excess adventure, even for the blasé.

The ship pitched forward and Elija felt another tadpole of sweat wiggle down his scalp toward the puddle near his hatband. He gripped the arms of his chair and tried to feel grateful. In conventional circumstances, the imminent fall would be inevitably and redundantly fatal. Not that a cruise ship could get in this predicament in conventional circumstances.

Elenor Cauless, Acting First Mate, studied her husband's profile. She

knew that he, too, had to be terrified and his self-control nurtured hers. Still, her fingers twitched with an urge to crochet until the crisis had passed, but regulations were regulations. . . .

Set into ebony panels in the room's zebrawood wainscoting, constellations of colored lights twinkled while the pointers of a hundred gauges twitched. All for show, as was the oversize pilot's wheel with its golden spokes inlaid with fossil ivory. On wonderliners the rule was Form Follows Function, and a vital function here was dazzling passengers visiting the bridge. Above the wainscoting, the wall was a curving 230-degree virtual window, revealing nothing but aquamarine sky and sparse pewter clouds. An extra virtual port had opened in midair, displaying the crinkled turquoise ocean so far below.

Elija reached out without looking and patted his wife's hand, courteously using his dry fingertips. "This is going to cost us, dear heart," he said quietly as the wonderliner finally began the big plunge.

The drop seemed interminable; the wind's fugue through the superstructure rose to a tortured shriek—then terminated with an abruptness that suggested a terrible impact. In fact, the ship had landed as gently as this-tledown settling on a pillow.

Elenor took in the sea-level scene outside, let her breath out with a whoosh, stood, and began massaging her husband's shoulders. She knew he wouldn't relax given the scale of their current problems, but she needed an outlet for her own nervous energy.

His muscles remained taut as guitar strings, but Elija was comforted by the gesture. He looked at the microphone, but decided to treat the incident as too trivial for comment. Glancing around to certify that he and Elenor were still alone, he released the ghost of a sigh before reiterating, "Going to cost us."

Neither officer had any doubt about what, or rather *who* had saved them. They'd been counting on him. Moelqai, the ship's Green Angel, had performed one of his "miracles," opposing local gravity with gravity accessible to one of his extensions, perhaps using an external frame of reference to pull inertia's sting. That's the sort of thing a Conductor was paid to do and a secondary reason for the title "Conductor."

But a troubling question arose: how *much* had he been paid this time? The captain only had seventeen "deeds" left to spend. Would Moelqai consider this latest intervention a single miracle, using one deed, or would he try to unfairly squeeze several from the incident?

Incredibly, the decision was left to the Angel. Perhaps the Angels had demanded such control. Or perhaps the owners' faith in Angelic honor was as naïve as Angelic faith in the owners' generosity. This particular cruise (cover your ears)—"A BRACING EXCURSION THROUGH FIVE NON-PARALLEL UNIVERSES!"—had required far too many interventions already, and the tour wasn't half complete.

Lately, Moelqai had been a paranormal sparkler, shooting miracles right and left. This was a major problem, because the *Mistral Majesty* would never return to Earth if he paid his debt in full. Green Angels refused to work on credit.

"I didn't actually *believe* that any watertitans could still be feeding this far north," Elenor murmured.

"I love the way you reproach me," Elija said. "The more I deserve it, the milder you become. Most people would have allowed themselves at least one 'I told you so.'" Privately, the captain was puzzled and distressed; that monster had no business being there!

The adult titan, implausibly tardy in its seasonal migration, had plucked

the sixteen-hundred-foot vessel out of the cooling Round Sea waters and hurled it like a javelin. The power in its grasping tentacles had exceeded the most gullible belief. And Elija was anything but gullible.

"Cari," he commanded, "where is our Conductor at present?"

Cari was the ship's Communications And Reconnaissance Integration: a seven-terahertz marvel with the latest co-acting, co-processing, and subjective capabilities. Considering the nautical aspects of its domain, the phrase "all the bells and whistles" was, for once, apt.

"Mr. Moelqai," said a feminine voice less mechanical-sounding than Elija's, "is currently in Delta Casino, Captain."

Protocol demanded a face-to-face meeting.

"Dear heart," said Elija to his wife as warmly as his sense of propriety would allow, "you have the helm. I'm going to interview our guardian Angel and find out where we stand."

"Aye, aye. And meanwhile I'll find out where we're standing. Have you noticed how *still* the ship is? Best luck, darling!"

His fastest path to Delta Casino was to take a lift to Gamma deck, ride the slipway to midship, and cut through a storeroom stuffed with the tackle, helium tanks, and balloons used for sky-fishing. Then, after passing the holy of holies for his casino programmers—a mu-metal and lead-shielded room where a thousand Luminglas lightning disks generated truly random numbers—he would take the nearest lift up one deck. A dozen steps would then bring him to the casino entrance.

En route, Elija considered his wife's final words. He needed more than mere luck.

The owners always hired married couples for the ship's top positions to discourage romantic trysts between chief officers and patrons, and they in-

sisted these couples trade roles every cruise to minimize lawsuits over sexism. Elenor had suffered as many direct encounters as he with Green Angels, so she knew that every Angel was different, yet each had a surplus of ego and a deficit in courtesy.

But Moelqai—ah Moelqai!—stood out from his fellow eccentrics like a sequoia whose companions were shrubs.

Elija studied the large room and the movements of its denizens as if he were assessing wind and waves before venturing from harbor.

The thousand-credit chips were platinum with an electronic anti-theft "signature." Each blue or yellow topaz in the chandeliers was mounted in an eighteen-carat gold bezel; the appointments were thickly layered in twenty-four-carat gold and coated in rock-hard plastic to discourage the surreptitious fingernail.

Delta Casino was rich in expensive alcohol fumes, bejeweled men and women, and perfumes worth hundreds more per ounce than the precious metal contouring the edges of blackjack tables.

The place was mobbed. Had any of these monomaniacs, Elija wondered, even *noticed* the latest crisis? Thick wisps of virtual cigarette smoke provided a convincing ambience, and obscured the less convincing details of the virtual dealers, robots with holographic "skins."

Elija counted three obvious security officers and another four dressed as guests. Rather few for such a large crowd, perhaps, but he trusted his security chief. Besides, the filthy rich are seldom bellicose. Elenor had once speculated that vaults crammed with "old" money might cast a tranquilizing influence.

The captain caught the eye of his floor-chief, Lila Breckenridge, crossed his arms keeping both hands visible,

and began tapping his fingers as if he were a bit nervous, communicating in the private code he'd invented while he was still commanding normal cruise ships.

The code, which he'd named "twitchtalk," had originally been a simple set of possible questions, responses, and instructions intended to circumvent eavesdropping passengers. Over the years it had evolved into a fully realized sign language. The force propelling this evolution was Elija's desire to circumvent eavesdropping Angels.

He informed Lila that he wished to avoid official recognition and she began silently passing the word to the other staff members. Without cues concerning his status, most patrons would only see another tall man in a white uniform.

After she'd done her part, Lila did some twitchtalking on her own behalf. Something was wrong here, but no one on her team could be specific.

Indeed, the casino's atmosphere was troubling. To Elija's sensitive ears, the room didn't *sound* right.

As usual, the clinking of ice added an extra syncopation to the clicking of dice, the staccato thrumming of three roulette wheels, and the whiffling of cards. He couldn't quite pinpoint the new element, but thought it might be a very subtle echo. Was Moelqai amusing himself by toying with the ceiling's precisely engineered acoustics?

Elija glanced upwards; nothing appeared different. The cross-vaulted overhangs rose to peaks of twenty feet, tall as any in the ship excepting the magnificent Alpha Ballroom. The concave overhead surfaces were embellished with sea-snail pearl carved to suggest tarpon scales.

He listened closely for a minute, using one of his unusual talents, a phonographic memory, to record nuances for future consideration.

But something aside from acoustics

was off. As to what, Elija was completely at sea. . . .

For this cruise, the owners were trying a profit-increasing experiment. They'd eliminated several card tables and added two extra roulette wheels, oriented vertically. As usual, Moelqai held court near the largest of these, in one of the six places in the room where the ceiling reached a pinnacle. He needed the added space. Angels are big, but he was a tower: well over nine feet tall, not counting the compound wings which rose another eight feet.

Admirers, mostly women, surrounded him. His heroic arms stretched indifferently across the naked shoulders of three beauties on either side.

Even folded, his wings were tremendous, the feathers a spectrum for beginners, shading from iridescent green to iridescent turquoise, lightly dusted with frost—a sign of recent thermodynamic exchange. Cobalt feathers with an emerald shimmer hid whatever he used for legs.

In reality, the corporeal part of Moelqai, the "local node," was the smallest part. Those overlapping force fields comprising most of his true body were larger than the ship, not even counting multiple extensions into other universes.

Until fifteen years ago, no one on Earth had heard of the Deta, dubbed "Green Angels" from the moment their images hit the ET channel. After seeing them in action, Elija thought that "Snow Angels" would've been more apropos. By then he was thoroughly sick of the lot.

The powers that seemed so magical to humans, from clairvoyance to inter-universal teleportation, resulted from an awareness that could be shifted to anywhere within several cubic miles and the capacity to tap energy discrepancies between universes. Is it clairvoyance to know what's happening in the next stateroom when one

part of you is already there? Is it teleportation to pull yourself into another reality where you already have a toehold?

Moelqai, however, had one Detan ability Elija hadn't previously encountered: tight control over the structures of his local node. The Angel had manifested a human face for the wondercruise: an Apollonian façade with bronzed skin, a long Roman nose, tight brass ringlets with bronze highlights. But the fires in his huge dark eyes suggested Apollyon more than Apollo. . . .

Across the room, Moelqai stared at the captain as if they were alone. Very slowly, a smile widened the chiseled cheeks, white teeth blazing like condescending suns.

Elija refused to be baited. At the proper moment, he joined the crowd-flow, working his way toward the big roulette table.

Halfway across the room, a waiter came within a baby's hair of stumbling into the captain. If the man had sprouted a propeller and taken off, Elija wouldn't have been more astonished.

For Captain Cauless had a rare gift aside from his perfect sonic memory: a genius for analyzing patterns. His course through the mob had been as sure as if it had been charted. The waiter's sudden presence was a violation of principles that Elija had intuitively followed his entire life.

The mystery was a severe distraction. When the Angel spoke, loudly, Elija was surprised again: he'd already reached the roulette wheel.

"Ah, the captain himself honors me with his presence."

All heads within earshot turned to stare at Elija. So much for remaining incognito.

"To what joyous happenstance do I owe the honor of this visit?" the Angel asked, smirking more blatantly.

Moelqai's voice was deep, melodi-

ous, and unctuous. His English was laser-perfect. Repeating the word "honor" had been a calculated insult, but not, Elija felt, the Conductor's best work.

"I'm here to thank you for your latest intercession," Elija said. "And to ask how many deeds your work required."

"How thoughtful! I believe the total comes to—let me tally now. That watergiant picked us up callously; I was forced to act. Then it briefly turned us sideways, requiring some gravitational realignment on my part . . ."

Sideways. Elija had a horrifying vision of the casino as it would have been without superhuman aid: a fairly narrow room with a cross-vaulted wall and a hundred-foot ceiling. Passengers and gaming tables falling to death and destruction.

" . . . and it threw us vigorously. Sadly, human vertebrae are no match for such acceleration; I was forced to expend another deed there. Soon, we had a matter of air pressure to contend with. Then, as we began to fall—"

Elija worked to keep his expression calm: "Can you answer my question now, or should I return at a more convenient time?"

"Ah, yes, Captain. I'm sure you have many pressing concerns at the moment. The grand total comes to fifteen deeds."

For a moment, Elija could only stare. A mere two deeds remained, precisely how many it would take to return to Earth. One for the "take-off," another for the "landing."

Twenty deeds normally covered an *entire* wondercruise, and they'd begun this one with fifty, a comfortable margin. Ironically, the owners could have provided thousands of such credits without feeling pinched. But obscene profits only whet obscene appetites.

An extra glint in the midnight eyes

showed that the Angel was savoring implications. Yet, behind that glint and the aggressive smugness, Elija thought he glimpsed . . . what? Impatience? Desperation? What was troubling this egomaniac? Elija didn't know and lacked energy to ask; it took all his strength to withhold the accusations bursting in his heart. His complaints would only amuse his tormentor and he certainly couldn't let the passengers know the score. Presently, he could only accomplish one sensible thing: buy some thinking time.

"Thank you for your candor," he said quietly. "I'm afraid we've been squandering your deeds too freely. Therefore, I'm officially requesting you to refrain from aiding the ship without my prior approval. Is that clear?"

"Clear as ice, Captain. I hope we face no emergencies requiring an instant response. And I *do* look forward to our next chat."

Elija spun around, walking back through the casino with an upright confidence that defied the fear and responsibility squatting on his shoulders.

Clear as ice? What kind of game was Moelqai playing?

Elija Caulless wasn't an easy man to like.

Among the staff, several called him "Captain Callous," or the more esoteric "Captain Ka-less." Significantly, no one even considered "Captain Clueless."

It wasn't just the crew that slung names. Among his acquaintances—of course, most were temporary—his self-control was often interpreted as a lack of humanity. The pretentious among these critics referred to Elija as an "automaton"; those less stuffy said "robot."

But Elenor knew her husband. "More trouble?" she asked.

"Moelqai claims to have used *fifteen*

deeds on that last rescue. Fifteen!" He switched to twitchtalk; Moelqai could be listening and might understand any of the six languages both Elija and Elenor spoke fluently.

"Am I an unreasonable old fool," he tapped, "for suspecting our latest Angel of outright fraud?"

Elenor's eyes flashed at the notion of anyone, including Elija himself, considering her husband foolish. "Of course he's cheating!" she responded. "But if he's so dishonest, why does he maintain the pretense? Why not simply abandon both his debt and us?"

"I've been asking myself that very question. Perhaps he can't. Perhaps Angelic promises . . . bind Angels the way gravity binds us. How's that for a wild theory?"

"Your theories are firmer than some people's facts. I have a confession, dearest. Right now, I'm glad it's your turn to be captain. What are we going to do?"

Elija stifled a shudder. Being in the power of a being with so little integrity and less compassion chilled him to the marrow. If only I had time, he thought, to just *look* at you for a while, my love. "First, tell me where we are and if anything dangerous is nearby."

"We were thrown about three leagues due north. The surface of the Round Sea is frozen here—barely. The 'water' you see outside is a thin, but remarkably sturdy . . . well, ice of a sort. We're essentially aground, quite stuck."

"Ice. Remarkably sturdy, you say? Are you certain we're still in the Round Sea?"

"Dearest! Even a watertitan couldn't throw us *that* far!"

"Do you really think a titan could throw us three leagues? I was wondering if our Angel had finessed us into another universe."

"Oh, my. There's an idea! That could explain the pseudo-ice. Cari

claims it's actually a water-based polymer."

"Captain," said an anechoic voice, the voice of the ship's integration when using a subjective channel.

"Speak aloud, Cari," Elija responded, speaking out loud himself. "I've no secrets from my First Mate." And nothing Cari could tell him would surprise the Angel.

"As you wish, sir. Piezosensors indicate severe and increasing pressure on the hull."

"You've informed engineering?"

"Chief Gomez is working on the problem."

"Have you determined the cause?"

"Spy-eyes have been sent out, but so far their reports are inconclusive."

"Does the pressure threaten us?"

"If it keeps building at the current rate, Captain, the hull will fail within two hours."

Moelqai had mentioned that Elija had "pressing concerns." The full cruelty of the remark had become evident. Or had it? He'd added the word "many"...

"Cari, tell your sp'eyes to look for iceworms."

The virtual probes had a limited intellectual capacity and were probably scanning for geological or meteorological conditions to explain the pressure. Animals, no matter how obvious, would be invisible to such search algorithms.

The response was almost immediate.

"Very good, sir!" Cari exclaimed with simulated admiration. "In principle you were right: creatures have been found, but not iceworms. We have encountered an unknown species."

"Display."

An image appeared in midair. Amorphous beings resembling animated snowdrifts were gliding over the ice from all directions, obviously drawn to the wonderliner. Several layers of

them were already pressed against the hull and more were arriving continually.

"What do they want?" Elenor asked.

"These are an unknown species," the integration repeated. "They discharge colorless gasses poisonous to humans. We are surrounded by a highly toxic cloud. I've arranged to block all vents and keep our internal air scrubbed."

Elija's thin lips grew thinner. "Cari, I want you to run a full ontological sequence; determine if we're still in the Horseshoe metagalaxy."

"Yes, Captain. Working..."

"Meanwhile, dear heart," he tapped, "let's discuss our dilemma. As I see it, we have two choices, equally atrocious."

Elija shared his thoughts and he and Elenor reached some conclusions. No matter what happened, they agreed, the cruise was finished.

If they stayed here, the Angel would surely invent some pretext for erasing his last two deeds and the ship would be lost forever in what Elija suspected was an unknown universe. Of course the passengers and crew wouldn't suffer for long; the frigid poison-spewing monsters crushing the hull would see to that.

But if the captain ordered Moelqai to instantly return the wonderliner to Earth, what then? They couldn't trust that he would act faithfully. If the trip somehow required *one* extra deed, that would be that.

And even if by some true miracle they made it home, the economic penalties would hurt. Metacosmic Expositions, parent company of *Mistral Majesty* and her sister ship *Aeolian Marvels*, would be forced to write thousands of first-magnitude refund checks.

In their miserly indignation, the owners would make damn sure to capsize two careers.

Decision was impossible. The First

Mate finally suggested that Elija leave the bridge and the problem, go to their cabin, and let his mind clear for a few minutes.

"Let the under-mind undertake when the over-mind is overwhelmed," she'd quoted from the Neme sage, Balanced Clearhouse. In their private refuge, perhaps at least the shadow of a useful idea might become visible.

Three decades ago, while humanity was still reeling over the discovery that our universe was merely a sub-facet of a geodesic superspace, we found something new to reel about. Or rather, it found us. Ambassadors from another sub-facet, the Nemes, came for a visit and let us know that when it comes to sentient ultra-alien—extraterrestrials from another universe—the pan-cosmos was very well endowed.

Elija had been as excited and thrilled and worried as anyone. The future practically glittered with possibilities.

Now he stared out the cabin's curved window asking himself how he'd gotten into such a mess. If his under-mind had any suggestions, his over-mind wasn't listening. Circumstance, he thought with more bitterness than philosophy, is the engine of fate. And "ifs" are its oil.

If our universe wasn't poisonous to them, he told himself, Angels could mine their own damn thulium. Or, if it was *instantly* lethal for them, they couldn't dive briefly into our cosmos like those fish-seeking birds that depend on angle and momentum to keep from drowning. They couldn't grab a wonderliner and drag it across the ocean of superspace.

If thulium wasn't unique to Earth's universe, ditto. And in either case, Elenor and I wouldn't be so far up the creek that I can see the sewer outlet.

If the Deta hadn't found a third party, that Neme diplomat and trader

Clever Tenth-house, willing to negotiate with humans on their behalf...

And why ask human financiers to build cruise ships anyway? Why should Angels offer to conduct "PELAGIC CRUISES THROUGH VARIOUS HARMLESS BUT HIGHLY ENTERTAINING REALITIES" in exchange for anything? Why not load their Neme shill with rainbow diamonds, or some such, and simply *buy* tons of whatever they wanted?

The Deta, Elija brooded, will only say they need thulium to preserve an important star. The only use he knew of for thulium was in magnetic cooling. Maybe the Angels were planning to put their star on ice.

Another issue had long troubled him. Every universe requires at least one unique, usually minor, variation in natural law to maintain an autonomous existence. These tiny variations often have far-reaching consequences. If Earth's reality is deadly for Angels, how could any reality be safe for humans *and* Angels?

And why, he thought, has this cruise gone so horribly wrong? The owners made sure we had a healthy surplus of deeds, as always. And since Moelqai would have his unspent deeds cleared when the excursion was finished, why should he cheat to get rid of them? If the ship were lost or returned prematurely, the Deta would most likely be out of the job they'd worked so hard to create.

For no clear reason, the captain turned to stare at a piece of artwork adorning his cabin's stern bulkhead, the finest example of needlepoint he'd seen, even discounting his bias toward the artist.

His wife had laboriously made it in secret, giving it to him on his fiftieth birthday. In the background, a clipper ship almost visibly sped upon a celadon sea. The foreground waves were sailed by elegant calligraphy rendered in thin, dark, but translucent

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threads. Here were the complete lyrics to Elija's favorite song, a neo-folksong written before the end of the twentieth century.

Elija had only heard the piece performed once; but with his memory, twice was superfluous. Its title was "Captain Cautious," and the coincidence of names had always tickled him.

Elija was appalled at the time he was wasting. Did he expect a solution to pop out of the tapestry? Involuntary, he reheard the complex strumming on a Martin D-28 and a baritone voice singing. The music in his memory had the rollicking rhythm of a choppy ocean, but the lyrics were slow and measured, riding the beat like a ship traversing deep-sea rollers:

*It was then in the middle of April,
When we finally set to sea
In the captain's safest clipper ship;
She held twenty-eight sailors and me.*

*Our ship had been built
by Romanu the Shipwright
And he'd named her the Gypsy's Slave.
She had inlaid oars,
teak and rosewood doors,
And she rode high on the waves.*

*Captain Jack, he wasn't
no coward, oh no!
But his soul lacked all romance.
He said, "If I can help it, men,
We shall never take a chance."*

*Chorus:
Lower the sails before the gales;
We are here to be rich men, not brave.
Jewels and gold, may line the hold;
But I'd sell my own brother to save . . .
The Gypsy's Slave.*

"Captain," interrupted Cari, "you have two calls. One from Chief Gomez and one from Security Chief Jackson."

"Put Gomez through and tell Jackson to stand by—override this if his in-

formation can't wait."

"Esmerelda!" Elija called out instantly. "Have you found a way to reinforce the hull?"

"Yes and no. We've applied orthomagnetic shores across the width, but they can only do so much. Cari tells me we've got maybe another hour before we pop. That's not nearly enough time, but shouldn't we start evacuating the ship anyway?" Gomez would've sounded calm except that she never sounded this calm.

"We can't evacuate. We'd need thousands of gas masks—Cari says it's foul out there. Anything else?"

"Not on my end, Elija."

"Glad you called, needed to talk with you anyway. Gotten any hints about why those . . . ice-squids are drawn to the ship?"

"No."

"Anything you haven't told me?"

"Just that the hull's gone crazy frigid. We can't figure out why."

"Oh? Our new pets seem made of snow and frozen spit, and they're cuddling up to us. Doesn't that explain it?"

"Captain, it's cold outside, but the hull's fifty degrees below ambient temperature. The monsters' body temperatures are less than *forty* degrees below ambiance."

"Indeed? I wonder—" Elija stopped himself. Moelqai could be hearing every word. "I'd better let you get back to work. Keep in touch."

"Whoa! Sounds like you found a handle of some sort. Why not show me where to grab hold?"

"Not yet, Essie, don't want to mislead you. I'll tip my hand if I can find some proof."

"Better be soon!"

"I promise. Bye for now. Cari, put Jackson through. Dan?"

"Right here, boss," the security officer drawled. "Just lettin' ya know—the un-natives are gettin' restless. Even the crew. Everyone's acting . . . odd."

Elija remembered nearly being bumped by that waiter.

Jackson lowered his voice. "Honest-to-God brawls have broken out in Epsilon Casino and Starboard Beta deck."

"*Fistfights?*" Elija tried and failed to conjure up an image of tourists swinging fists twinkling with diamonds, sapphires, and non-parallel emeralds.

"More like shovin' matches. Patrons are still patrons. Wouldn't want to chip a nail or wrinkle a video shirt! But the vibe aboard has my team worried. Everyone's so pissy. I've been working for Metacosmic for . . . what? Seven years now, and never felt nothin' like it. Maybe it's 'cause the ship ain't going nowhere. What do you think, boss?"

"I think our Green Angel is having fun, Dan. When I can tell you something definite, I will. For now, it's extra shifts for your people, with time-and-a-half to make the hours pass more pleasantly. Do your best."

"Count on it. Ya know, somehow I always feel better after talkin' with you or your missus."

"Glad to hear it, Dan. And, just between us, sometimes Elenor can even help me unwind. Take care."

Calls completed, Elija pondered the idea that had breached from his subconscious.

"Cari, I want you to monitor the hull temperature. Keep me informed of changes."

"Yes, Captain."

"How far away can you send a virtual probe?"

"Power is the constraining factor, sir. At the moment, I can send a sp'eye about a league."

"Fine. Dispatch one, have it travel slowly in a straight line as far as you can push it, and have it transmit back continual temperature readings."

"As you wish, Captain. Would you care to hear the results of the ontological survey you requested?"

"Yes! Are we still in the Horseshoe

universe?"

"No, sir. And I haven't yet identified which universe this is."

"Can you tell me what's different here?"

"Some conductive materials briefly develop a slight positive charge after passage of an electric current, increasing their conductivity. The degree depends on frequency of use as does the amperage of the eventual discharge."

Elija hesitated. "Wouldn't that interfere with all our electronics, including you?"

"Ship systems are using redundancy to minimize the effect."

Minimize, not eliminate, Elija thought. "That's all for now, Cari."

"Where was I?" he mused, pulled again, irrationally, into the rolling lines of "Captain Cautious."

*On the twentieth day
we were becalmed,
The water looked as frozen as ice.
And the captain, he paced to and fro,
And he begged for our advice.*

*But the currents were
neglecting their duties,
The trade-winds had forgotten to blow,
And at the end of my watch
on the twenty-fifth night
I heard a sound from down below.*

*I climbed down the bilge-way ladder
And thought I'd gone insane:
In the swaying light
of the hold's oil lamps,
Two figures were playing a game. . . .
One of them was the captain,
holding five cards like a fan;
But the other, he was a stranger,
and wasn't a natural man.*

*He had hair that floated like seaweed,
His skin seemed to glow in the dark.
He had the big bulging eyes
of a deep-water fish,
And rows of teeth like a shark.*

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By now, Elija was unconsciously mouthing the lyrics, but the many parallels between Captain Jack's weird predicament and his own suddenly stilled his lips.

"Water looked as frozen as ice" indeed! And the story involved a supernatural being with supernatural powers, gambling, and a journey made for profit.

By God, Elija thought, the "under-mind" is trying to tell me something after all! Perhaps—

"Captain," Cari interrupted again.

"More calls?"

"One sir. From Chief Donaldson."

"Put him through." Privately, Elija groaned. Wilhelm Donaldson, chief of gambling and entertainment, moved through life at a pace closer to moribund than leisurely.

"Mr. Donaldson, what can I do for you?"

"Good afternoon, Captain Cauless. I trust you are in good health?"

"Still breathing. My problem today is time."

"In that case, sir, I'll make this brief. Very brief. I merely wanted to inform you that all eight managers of the eight casinos on our splendid vessel have sent in some, hmm, *unusual* reports today."

"Go on." There's never a cattle prod handy, Elija thought, when you really need one.

"As you must know, we have our house-odds rather carefully crafted?"

"Yes?"

"Ever since we fell from the sky, all casinos have consistently defied statistical comfort."

Elija struggled to interpret the arcane statement. "You're losing money?"

"Oh, no! No, sir! Profits are still acceptable, but they aren't accruing in the patterns we expect—the way they're *designed* to accrue."

"I see. You think someone is tampering with the equipment or perhaps

the RNG?"

"Hmm. Well. No one, I'm sure, could influence our random number generator. You, of all people, should know how secure we keep that room and how well we protect *that* circuit! Should I remind you how much pride my department takes in the, um, refined honesty of our slots and other strictly mechanical games of chance? The purity of the RNG is essential!"

The captain said nothing and tried not to grind his teeth.

"As to rigging the mechanisms themselves, an investigation is underway. I merely wanted to keep you apprised."

"Thank you, Mr. Donaldson. You've been most helpful." Elija hoped he hadn't sounded as sarcastic as he felt.

"Cari," he called out as the connection was terminated. "Hold all calls for the next five minutes."

"As you wish, sir."

... and rows of teeth like a shark.

*The stranger said,
"I'll see your twenty-one men,
And throw eight more into the pot.
So would you like to fold, my friend,
Or would you care to
see what I've got?"*

*The captain nodded cheerfully
And put down two queens
and two tens.
He said, "If you've got the better hand,
You can have me and all of my men."*

*Well, the stranger laid out
a diamond flush,
And his eyes gleamed
with greed like a child.
My heart filled with dread
as the webbed fingers spread
But the captain just
sat there and smiled.*

*Then Jack, just as fast as a moray eel,
Grabbed the stranger's cards*

*and set one apart.
With one calloused thumb,
he rubbed off some red gum . . .
Beneath that diamond
beat a red heart.*

Elija's own heart was beating fiercely now; was this familiar song really offering a way out of his predicament? He finished the lyrics in a rush:

*The captain, he said,
"Get me three blue whales
To tow us to our port.
Then thirteen dolphins
to guide us home,
Call them from
Neptune's inner court.*

*The winds shall be zephyrs,
so balmy and sweet
You'll fetch mangos and limes
for my crew
And I have an offer I think
you should hear
Concerning the next year or two."*

*Today, they still remain partners,
The captain and the man of the deep,
And all the other sea-merchants
Have to read of our profits and weep.
The captain still doesn't
take chances, oh no,
He says, "Chances can
lead you to grief.
But sometimes you've just
got to gamble, my son,
No matter what you believe."*

It was here! Elija thought. Almost a blueprint of how to handle the situation. But, dear God, it was going to be risky! The idea was so daring, so outrageous, that he had to clamp his jaw against a shout. Aside from the issue of dignity, he was afraid it would emerge as a howl of fear rather a roar of enthusiasm.

And the blueprint wasn't complete. He wouldn't be able to build the pot high enough to save the ship on a sin-

gle hand. He'd need a second trick. The song only suggested one and it was damn unlikely to work twice, if it worked at all. . . .

A more fundamental issue remained: would Moelqai be willing to play?

Elija saw one encouraging sign. No other Angel had so much as visited an onboard casino, yet Moelqai spent so much time in them, he might as well have been gilded along with the other fixtures. He'd never actually gambled, but then, he'd never had anything to gamble with. This crooked Conductor had evidently become fascinated by games of chance. By now, he probably knew all the rules and all the odds.

Don't worry, Elija told himself, he's too proud to turn down such a challenge—especially considering his powers. The *interesting* part will be trying to win two poker hands against an opponent who can be clairvoyantly aware of every card. For all I know, he might even be able to stack the deck at will!

To win that final hand, I'll have to be nearly as clever as Elenor thinks I am. And have a boatful of luck. . . .

He spent a stressful ten minutes devising plans and then rejecting them, increasingly maddened because possible salvation had seemed so close. So much for my cleverness, he thought. Will I have to take an idiotic risk and repeat the first stunt? There's *got* to be another way to rig the game!

The concept of rigging games reminded him of Donaldson's report, which reminded him of today's other casino anomalies. In the desperate hope that he'd learn something useful, he mentally replayed the sounds he'd memorized from Delta Casino, but at half speed.

What he heard was astonishing. Reasoning backwards from the effect, his heart racing, Elija traced the explanation to the one bizarre quality of this universe that Cari had identified. In

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this case, the effect was more important than its cause because it gave him an extraordinary opportunity. Maybe he could pull off the final trick through an outrageous fraud of his own!

Following orders, Cari contacted Lila Breckenridge on a subjective channel, asked the floor chief to step into her office, then patched through an image-to-image call between Lila and Elija.

Using twitchtalk, the captain asked Lila to stage a loud argument or provide a surprise floorshow—anything to keep Moelqai distracted for the next half-hour. Elija had much to communicate to Cari and couldn't afford any clairvoyant attention until he was finished.

That much accomplished, he had an image-to-image with his wife, tapped out his latest plans, and was gratified by her endorsement and even more gratified by several refinements she added. He admittedly lacked her "people skills" and could only hope those skills would apply to an ultra-alien. Finally he returned his attention to the ship's integration.

"Cari."

"Yes, Captain?"

"Describe the results of your temperature survey."

"You didn't suggest a direction for the probe so I sent it due west. The sp'eye reported that the temperature rose almost one degree Kelvin every hundred yards for 1.64 nautical miles and then abruptly fell thirty-six degrees Kelvin. That condition persisted to the limit of the probe's excursion."

"I thought so! Cari, I want that sp'eye to circle the ship at a radius of 1.65 miles and to report any temperature fluctuations."

"No changes reported, sir."

"That was quick! Thank you. Now I have new directives. How rapidly can you run poker simulations? A mere one or two billion samples should do."

"It's done."

He used his handkerchief to dry his forehead. He was reasonably sure what the simulations would show. But assuming he was right, he could only win by pulling off the bluff of his life. . . .

Acting on a new thought, he tapped a message with his left hand. Cari had certainly monitored enough training sessions between cruises.

"Yes, Captain," she said on a subjective channel. I do understand twitchtalk."

The size of his grin would've shocked most of his crew. Since Cari's subjective voice was accomplished via auditory nerve induction, Moelqai couldn't overhear it. And unless the Angel, too, had somehow learned the tapping code, private communications had just become easy.

That was a good thing, because Elija had a boatload of secret instructions to give.

"Show me those poker results," he tapped.

Moelqai's eyes flickered with the smallest hint of uncertainty.

"Perhaps my hearing is defective, Captain. Did you say you wished to play cards with me and sacrifice your final deeds?"

If any passengers had heard that question, it might have triggered a panic. Fortunately, Elija had correctly assessed his opponent's discretion; over the last fifteen minutes, undercover security officers had subtly displaced all Moelqai's sycophants. At the moment, no genuine patron could get within fifteen feet of the towering egotist, and the casino's background noise kept their conversation confidential enough.

"I want to play, Mr. Moelqai, but I intend to win." The captain put an Angelic sneer into his own voice. "I don't suppose you know the rules of standard five-card draw poker?"

"Bah! Any game simple enough for

humans—”

“You understand that the relative value of a given hand is dependent on the hierarchy of probabilities? And that equally rare combinations are adjudged on the basis of who holds the ‘higher’ cards?” These phrases were delicately convoluted, designed to encourage impatience. Would the Angel catch on?

“Captain. Are you deaf to barefaced insinuations? I know how to play standard poker, high-low, seven-stud, Texas hold ‘em, anything you want. I am pleased to accept your suicidal offer.” Moelqai’s irritation was manifesting as ruddy smoke wafting from his wide nostrils while ice formed on his eyebrows.

“Excellent,” the captain responded mildly. “I propose that each deed be assigned an arbitrary value of ten thousand credits. So we’ll begin with twenty thousand credits apiece. The ante shall be a single credit and no blinds—we don’t want the game to end prematurely, do we?”

“A one-credit ante? Ah, Captain, you display exquisite abandon! Your recklessness is terrifying!”

“One final point, Mr. Moelqai. Do you promise to honor the results of our game?”

“So! You’ve guessed what vows mean to a Detan. No matter, I do promise.”

“And do you agree to abide by the system I outlined to determine the winning hand?”

The Angel’s expression was an unstable mix of incomprehension, annoyance, and impatience as he stared at Elija.

“What is this? Everything you said was painfully obvious. I hereby agree to the obvious. Shall we get on with it? I don’t wish to keep my freedom waiting! How do we deal with the dealing?” Moelqai was so eager that his skin lost some of its artificial golden hue.

“We can take turns,” the captain pointed out, “or employ a house croupier if you prefer?”

This was the next crucial juncture; if the Angel insisted on taking turns, the final part of the captain’s plans would sink. But Elija had agreed with Elenor’s assessment that his opponent wouldn’t accept such a menial role. Plus, a cyberdynamic mechanism would be more easily susceptible to telekinetic tampering than Elija, who might complain if he felt some outside force manipulating his fingers while he was shuffling.

“One of your casino engines will do nicely. Doesn’t your tradition decree that we be seated for this? Have you a chair scaled for me, or must I manifest my own?”

“That won’t be—”

“Never mind. I perceive two men in a lift conveying something not utterly inappropriate.”

“We’ve had other guests built on heroic proportions.” Here, the captain was following Elenor’s suggested strategy of delicately juggling insults and flattery to keep the Angel off balance. “Behold! The casino door opens, and your throne arrives.”

Dan Jackson and a burly member of his security team were carrying a huge, low chair. Jackson’s bald head, the color of varnished teak, was glistening despite the air-conditioning. Elija had invited the security chief to be on hand; Jackson’s staunch optimism and moral support would be most welcome, particularly since Elenor was busy monitoring the wonderliner from the bridge.

“Afternoon, boss,” Jackson panted as he and his helper lowered the chair. “Anyplace special you’d like this anchor dropped?”

“It does look heavy. Put it behind that idle blackjack table, if you two would be so kind. I don’t think the floor manager will protest if we co-opt it for our own purposes.”

"Never mind, weaklings," the Angel growled as the two men struggled like exhausted weightlifters to re-hoist the throne. "I'll do it myself."

He's even more eager to remove those deeds than I dreamed, Elija thought. Now he's doing stevedore work!

With disconcerting ease, Moelquai lifted the chair with one arm, swung it over to the nearby table, folded his wings farther out of the way, and sat, tapping green felt with a foot-long forefinger.

By now, even the most jaded gamblers in the casino had noticed the Angel's unprecedented behavior. Drawn by novelty, people began crowding in, vying for a good view. The security team had to work wonders of their own to maintain domination of the area surrounding the Angel, particularly since the judicious use of elbows was ruled out.

The captain, using Wilhelm Donaldson as his role model, made a production out of emplacing his own chair—another ploy suggested by Elenor to put Moelquai near the boiling point, too angry for vigilance.

The table already had a virtual dealer wearing a Walter Cronkite "skin," and when the captain said "Five-card draw," it activated itself. Elija had always intended to look up the historical antecedents for the ship's holographic imagery, but he'd never found the time. He settled down in his chair with the alacrity of chilled molasses, and just as slowly pushed a silver one-credit chip toward the table's center until it bumped against the one already waiting. The game had begun.

His first hand contained a pair of aces.

"Acting Captain Cauless is seated to my left," the virtual Cronkite proclaimed in a neutral tone. "He will initiate betting."

"I'll wager ten credits."

Moelquai snickered. "Ten entire cred-

its, Captain? Don't overdo! I'll see that outrageous bet and raise you two hundred."

Elija matched the raise and discarded the three odd cards. In return, he received a pair of kings and the jack of spades.

"The play is to Mr. Moelquai."

"Well, well, Cauless. Let's explore what you're made of. I'll raise two thousand and eleven credits to make my winnings come out with an aesthetic symmetry."

"I'll see that and call."

4,444 credits sat in the pot.

Elija laid down his two pairs and the Angel revealed his own hand. It was almost identical, aces and kings, but the kicker was a queen.

A bad beat? Luck of the draw? Hardly. Moelquai had won by an intentionally narrow margin, another way to smirk. Elija was careful to keep his expression neutral. He hadn't been sure the Detan could work quickly enough to control the shuffle, and this first round would be more convincing if Elija didn't need the dealer to stack the deck. . . .

A barely audible grumble, a dozen swallowed groans, made Elija glance sharply at his officers around the table.

He shook his head. "Hope my luck improves," he said.

Elija was down to 17,778 credits—less than two deeds and no longer enough to buy passage home.

The next hand was a trash rainbow of clubs, hearts, and one pitiful diamond. He sacrificed his ante and folded.

"Doesn't suit you, Captain?" his opponent jibed.

He wasn't startled when the subsequent ten deals offered amazing temptations: full houses, flushes, and quads.

The captain smiled politely and rejected every one of them.

Each time Elija folded, the Angel be-

came a little angrier and even coined a new name for the captain: "Call-less."

The next hand was a king-high straight flush of hearts, exactly what Elija had been waiting for.

"I'll risk four thousand credits," he said softly.

Moelqai sneered. "About time you decided to play, Captain. I'll match your bet and raise, ah, ten thousand shiny credits."

That would leave Elija less than four thousand. . . .

"I'll see that; and I'm standing pat."

"Would Mr. Moelqai care to draw?" the dealer inquired.

"No. But I would care to raise. It will cost you 3,766 credits to admire my cards, Captain. I'd wager more, but this will clean you out."

"I appreciate your precision," the captain acknowledged, "but perhaps we can make this hand even more interesting. Would you consider an additional wager of 200,000 credits?"

"Absurd! You don't have it, and we Deta don't work on pledges."

"I'm not asking you to *work*, Mr. Moelqai. Just accept a promissory note. Why not? What would you have to lose?"

If emotion was water, something akin to surface tension was accumulating around the table. The passengers couldn't overhear the game conversation, but the security people had their own lives and futures at stake. No one on Chief Jackson's team groaned again or so much as chewed their lips, but they were afraid. Elija could feel it in his stomach and on the back of his neck.

Keeping his face expressionless, he glanced over at Jackson and was tremendously if invisibly grateful to receive an encouraging grin and a brief thumbs-up sign.

"How would you pay me," demanded the Angel, "if I agreed to accept your imaginary note? Surely you're not dreaming that I'd be forced to return

you to Earth in order to collect? Is that what this foolishness is all about?"

"No, Mr. Moelqai. I wouldn't dare presume on your mercy. I was hoping to work off any debt incurred."

"Work it off? You'd be *my* servant? What a refreshing concept! You tempt me, Captain, you really do. By Seris, so be it! This is an historic moment, ladies and gentlemen: I accept your promissory note, sir, and look forward to our new, happier relationship."

Without fuss, Elija laid out his straight flush and watched Moelqai intently. He put one hand on the felt and tapped the word "Go." Cari would handle the rest. . . .

With a flourish, the Angel threw his cards high into the air. They landed on the table with a slap in the face of probability: in an upright semicircle facing the captain, each card cleverly supporting the next. Moelqai cackled and reached for the pot, fresh icicles dangling from his wings.

"Looks like I win this hand," Elija observed mildly.

"What? You spout nonsense! My royalty defeats your straight flush!"

"Sadly, you don't have a royal flush. Here, see for yourself. . . ." Elija gently blew the cards over so that Moelqai could study his own hand without any clairvoyant bother.

"Where did *this* come from?" the Angel howled. He held up the jack of clubs and shook it as if he were trying to break the jack's neck; his other cards were spades.

"You must have misread it," Elija suggested. "After all, clubs and spades, they look much alike."

Moelqai didn't answer. The captain tasted copper in his mouth and guessed that the Angel was gathering energy. A crimson flash set human eyes blinking . . . but the jack remained a club.

The Green Angel stared at it in disbelief, so upset that his local node began changing, his face slumping into

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an irregular spheroid of crystalline emerald. Elija was alarmed at the intensity of Moelqai's reaction. And he asked himself again: why the hell was this Angel so anxious for his duties to end?

Elija had now amassed 235,534 credits—over twenty-three deeds, even subtracting the 4,455 credits remaining to his opponent. He'd won the round, but the fight wasn't over.

Poker can be a psychological magnifying glass. All along, the captain had been using it to examine the Angel, testing Elenor's ideas about him. Elija was now coldly certain that no amount of deeds would get the wonderliner back to Earth. If he ordered the transition, Moelqai would instantly manufacture another expensive crisis, or accelerate the present one. Elija hadn't really won a thing, but he had to feign triumph.

This was perhaps the trickiest part. . . .

"I thank you, Mr. Moelqai, for a truly enjoyable experience."

The Angel reassembled enough of a face to regard him balefully. "Where are you going? I've still got chips! Sit down, we're not done yet!"

"Sorry, but duties call—"

"No. I *insist* on continuing our game."

"Why should I? I now hold a large fistful of deeds. What purpose would be served by—"

"You will sit! I don't know how you managed to fix that last hand, but I promise you this: if you walk away from this table it will be the most extreme mistake of your brief life."

"Threats, Mr. Moelqai? I respond better to incentives. Here's my best offer: We'll start afresh, each with 10,000 credits, but we won't be playing for deeds this time."

The Angel was silent for a moment. "What then?"

"If you win, your previous debt will be cancelled, you'll have the ship, and

I'll be your servant as I offered before."

"And if I lose?"

"You'll provide us a free trip—every miracle the journey requires."

"I'd be a *slave*, human!"

"Nonsense. You'd simply be doing your job. The job you'd already contracted to do."

"You astonish me, Cauless! But I agree to your terms . . . with a warning: I am going to insure that *nothing* interferes with the nature of the cards. Your innovation, whatever it was, will no longer operate, do you understand me?"

"Certainly," the captain said, sitting down again. "Dealer, you may—"

A deafening metallic explosion echoed through the wonderliner, so shocking that even the Angel half-stood. For a few seconds, only the clattering of roulette wheels and the programmed patter of dealers disturbed the silence.

"Captain," Cari said, using a subjective channel while over seven hundred voices simultaneously erupted in the casino, "you have six emergency calls."

"What blew up?" Elija tapped.

"Nothing, sir. The hull's shape suddenly altered slightly to accommodate the increasing pressure."

"Mr. Moelqai, would you excuse me for five minutes? I need to consult with my staff."

"Ah, Captain! I fear the skin of your craft is beginning to buckle; perhaps the construction isn't as adamant as you believed. You possess a surplus of deeds at the moment. Why not have me institute repairs and deal with the creatures causing the problem?"

"Not yet, thank you." If Elija left it up to the Angel, those would be the costliest repairs in the history of overcharging!

"Very well, I shall be gracious and spend the time savoring your upcoming defeat. Our game resumes in five

minutes—*don't* keep me waiting."

"Cari," the captain called out from the privacy of a nearby storage room; he'd wanted to handle this without having to look at Moelqai. "Who's on the line?"

"The First Mate and every department chief excepting Chief Jackson."

Most of these people didn't know twitchtalk, but Elija saw no reason for secrecy; the Angel already knew the score—he was the one writing it.

"Make this a conference call, Cari." He stole a moment to gather his wits. "Ladies and gentlemen, I assume everyone wants to discuss the recent unpleasant sound? Let's hear what our engineer has to say. Esmerelda?"

"Right here, Captain. That explosion, it was our hull adjusting to the pressure. We're finding out the hard way that our alloys misbehave in near-cryogenic conditions."

"Elenor, have you described our basic situation to all department heads?" "I have."

"All right. Esmerelda, how much time do we have left?" From the tone of his voice, Elija might have been inquiring about the dinner menu.

"Hard to say; Cari's estimate has changed for the worse. Maybe twenty minutes, maybe less."

The First Mate spoke up again, "Elija, Cari has been keeping tabs on your wonderful progress for me. Why not spend some of your winnings?"

"Wish I could, Elenor. Moelqai's so frantic now he'd probably charge separately for every inch he moved us, or for every ice-squid removed." Plus, he didn't say out loud, I need every deed I've got for leverage. "Esmerelda? Anyone figured out what those creatures are after?"

"We have a hypothesis, Captain, to explain the drop in hull temperature. We think our squidcicles might feed on heat; we're hoping that if we refrigerate the outer layer of the ship our-

selves, it might—"

"No. *Don't* do that!"

"Why not?"

"I had Cari check local weather; outside temperature rises steadily in proportion to distance from the ship. It drops off sharply about one and a half miles away."

"Which means?" Chief Gomez asked.

"Looking at those creatures," Elija suggested, "wouldn't you guess they'd melt if it got too warm outside? Odds are that you-know-who is using heat to chivy them toward us, and he's cooling the hull to make the monsters huddle up to it for protection."

Gomez's voice cut through the general murmur, "Moelqai, eh? So you think *we* should heat things up?"

"Exactly. Make the hull glow, and hurry. Pour hot water on those things—hot oil might be better—whatever it takes. Listen, Essie, I've got a poker game to finish, but call me on a subjective channel with the results. Cari, disconnect everyone except my wife. . . ."

"Elija," the First Mate said softly. "After thirty-five years you still amaze me."

"I'm afraid that congratulations, dear heart, would be premature. I only wanted to tell you that I love you . . . just in case. I may be wrong about everything."

A new kind of tension surrounded the blackjack table.

To Elija, everything felt magnetized, slightly sticky. From this, and the soda-pop tingle on his tongue, he knew that Moelqai's powers were busy, insulating the cards from contamination, virtual or otherwise. The force was strong enough to warp the dealer's appearance into something disturbing and interfere with the holomist projection around the fingers, rendering them obviously mechanical as they shuffled and dealt.

This round, Elija saw no hints that his opponent was manipulating the deck.

Nevertheless, he lost steadily. The Angel may not have been controlling the cards, but he was obviously using his talents to monitor Elija's hand. The captain could have used Cari's virtual eyes to do likewise, but was afraid the Angel would catch on and take some drastic action. So he merely played the odds. Whenever he had luck, Moelqai folded.

The losses weren't rapid; the captain kept his bets minimal, but his credits were evaporating.

"Elija," said Gomez, her normally resonant voice dull over the inductive audio link. "We have mixed results."

"Cari," the captain signaled beneath the table, "relay my twitchtalk to Chief Gomez and keep it subjective. Essie, I'm using Cari as a go-between," he tapped. "Make it quick."

"We're warming the hull and your plan's working to some extent. The pressure's still increasing, but slower. UV scans show that the innermost monsters are trying to escape, but there are too many layers around them . . . it's a damn traffic jam."

"Did you try hot oil?"

"Couldn't think of a way to get enough out there without letting poison gas in."

"How long will the hull hold?"

"Captain opens," the dealer stated.

"Fold," Elija announced aloud as Gomez said, "Without your idea, we'd be dead already. But I'm afraid you bought us an extra ten minutes at most."

"Do everything you can, and hang on. Bye."

Elija tapped on his nose, apparently lost in thought. The virtual dealer shuffled; a wave of suspicion washed over the Angel's fabricated expression, and the dealer sent ten cards twirling across the soft green table surface.

This was it.

The captain didn't need to look at his hand, but he did. A pair of fours. Four had always been Elija's lucky number. The Angel should have received the nine, ten, and jack of diamonds—plus two irrelevant cards.

Virtual dealers make splendid mechanics. . . .

Moelqai stared into Elija's eyes. He knew the captain had arranged this hand, and his clairvoyance had revealed what was in store . . . but not why. For a few blood-freezing seconds, the Angel hesitated and then said slowly, "I'll open with a thousand credits."

"I see you and raise two thousand."

"Interesting. Very well. I'll take two. Care for any cards yourself, Captain?"

Elija pulled his lips into what he hoped would resemble a smile. "Three will do nicely."

Now the Angel had a royal flush—diamond to match the song; and Elija had received the remaining fours.

"Captain's bet," said the dealer.

"Moelqai, I'm getting bored," Elija lied. "Let's finish this off. I've only got 5,000 credits left and I'm in the mood to go all-in. Can we agree to give the overall victory to whoever wins this hand?"

Again, the Angel hesitated, no doubt scanning the cards using every exotic ability he possessed. They were exactly what they appeared to be. Baffled, he finally said, "Very well, Causeless. Winner takes all."

The opponents both laid down their cards and neither bothered glancing at them.

"How," Moelqai demanded intently, "do you intend to conquer a royal flush this time?"

"With this quartet of fours; of course."

"Captain—perhaps I should say 'Servant'—both you and I and your Mr. Hoyle know that a linear flush beats a quad."

"Not today, Mr. Moelqai. Not here."

The Angel stared. "Has defeat rendered you insane?"

Elija clenched his hands together under the table. "Cari, play back my exposition of poker fundamentals if you would. Medium volume."

"Yes, Captain."

Elija's recorded voice said, "You understand that the relative value of a given hand is dependent on the hierarchy of probabilities? And—"

"That's enough, Cari. Do you remember agreeing to this rating system, Mr. Moelqai?"

"Certainly, but what possible—"

"You happen to have moved us into a remarkable universe."

The Angel's counterfeit face showed traces of emerald beneath the human guise; the effect was almost bilious, a sick foreshadowing.

"Remarkable in what way, Captain?" Moelqai demanded, none too gently.

Elija was near panic himself. Time was almost out and it could easily take too long to convince the Angel. And the whole plan was based on deceit! As if to buttress his fear, the hull chose that moment to emit another metallic screech.

He forced himself to concentrate. "As you know, Mr. Moelqai, every universe has its own variant of physical law. Have you been listening to results on the roulette wheel behind us? No one's been playing recently, but it's kept on spinning. Amazing how often the numbers have—wait, it just happened again! Did you notice? The previous spins came up 'Six,' then 'Sept' and, as you just heard, the latest was 'Huit.' When I first noticed the effect this afternoon, I mistook it for some form of echo.

"In my universe, and every one I'm familiar with, random events tend to happen in clusters. Here they tend to occur in *sequences*."

"Sequences?" The word emerged as a ghastly whisper.

"Cari," the captain ordered, "display

our poker simulation chart. Thank you. Our computer ran two billion random games, Mr. Moelqai. The graphic you are scowling at is empirical proof. In this cosmos, drawing a straight flush, even one with royal pretensions, is far more probable than getting four of a kind."

"No!" The Angel screamed, standing up, wings quivering and unfolding enough to knock aside two security officers. "NO!"

"Welcome to our new statistical reality! Here, random numbers line up in rows like obedient soldiers."

"This cannot be happening!"

"Perhaps Cari should run a few billion more simulations? Or perhaps I explained this too quickly for—"

"Enough!" Moelqai spat out. "Enough. Does enslaving me not satisfy you? Must you also torment me with supererogatory exposition?" The Angel flopped down again, emitting a moan so low that Elija could only feel it.

Presently, the captain could afford neither curiosity nor pity. "Suit yourself. Kindly take us to the next stop on our itinerary—I believe that would be planet Magenta in the Spiral Universe."

A strange peace descended. An emotional weight seemed to float off Elija's shoulders and he was amazed to realize that he'd been as edgy as his passengers. Evidently that local electrical quirk had been upsetting human nervous systems but his genuine anxiety had hidden the induced anxiety!

The clanging and squealing of the hull expanding as monumental pressures were released terrified nearly everyone on board.

To Elija, the cacophony was sweet music.

The crew's celebration in Beta Dining was getting raucous. Even Cari had co-opted a spare virtual dealer and given herself a "skin" based, mysterious-

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ly, on an actress in antique movies with an improbable name: Sissy Spacek. The mood was festive, and while the captain was wondering why he didn't share it, he got a subjective call from Wilhelm Donaldson. He'd never heard the manager sound upset before.

"I regret disturbing you, Captain. I understand you are in the midst of celebration."

"Why not come to Beta Dining yourself?"

"Alas, I'm engaged with duties at the moment. I've been analyzing our casino statistics taken over the last three hours and wanted to apprise you that someone *has* been influencing our roulette wheels. Several patrons have taken advantage of a certain, hmm, motif and increased their fortunes by placing bets on successive numbers." Donaldson paused dramatically. "We have lost money," he said in a tone suitable for announcing the imminent death of a loved one.

So, Elija thought, I'm not the only one who noticed. He would've been amused except that this was a dangerous topic, one that could snatch away Elija's recent victory if Moelqai overheard—and being on a subjective channel didn't mean Donaldson and he weren't vocalizing where they stood.

Elija had staked everything on his belief that beings with Moelqai's powers would have had no reason to develop scientific sophistication. His claim that the prior reality encouraged sequences had been unadulterated nonsense.

Thanks to Cari's ontological tests, Donaldson's original concern, and Elija's own phonographic memory, he'd unraveled the truth behind the strange behavior of the roulette wheels:

The previous universe's tendency for conductive materials to accumulate positive charges had turned the ship's random number generator into

a sequential number generator. Instead of haphazardly placed mini lightning bolts within the Luminglas disks, mounting residual charges increasingly attracted subsequent bolts toward an increasingly limited area—a kind of reverse-dielectric dialectic. Eventually, the positive charges would fade or short out and the process would switch to a new position. The robot roulette operators, as always, used the numbers assigned to these positions—numbers listed sequentially around the disks' circumferences—to determine how much pressure to use when initiating each wheel spin. And of course Cari had used them for selecting cards when simulating poker hands. . . .

"Captain?" Donaldson urged. "What should I do?"

"Nothing. I believe your problem has been solved. I'll explain more later." Elija didn't dare mention the RNG.

Perhaps Donaldson sensed Elija's urgency, because he didn't argue. "Very well, Captain. I take you at your word. Again, please forgive my intrusion." The channel closed with a subjectively audible snap and Elija let out a shaky breath. No more close calls today, thank you, he told himself.

He pulled Elenor aside. "Dear heart, I know I should be as pleased as this over-spiked punch we're drinking. But I just feel . . . hollow."

"Elija, my husband, the best a person can do is to follow whenever their spirit insists on leading. Will you ever learn to trust yourself the way I trust you?"

"Probably not." He turned to watch Chief Gomez teaching Dan Jackson a dance move. "Elenor, I've got something to do. I just don't know what it is."

"Then go find it."

Not for the first time, a few words from his wife were enough. He waved to the crew, crossed the cocobolo floor, and glanced back before he

walked through the entranceway. His wife was watching his departure, smiling.

To him, her silver hair seemed a natural crown and her slim form and graceful bearing made her appear vibrant and still youthful. Her eyes met his and a warm and private message passed between them.

Entering their spacious quarters, he felt a sense of relief; here and only here, he could be himself. But when he considered the comforts of the cabin's cumulous bed, a restless energy pulled him instead toward the large virtual port. The panoramic view displayed the Purple Ocean in shining, silken magnificence.

Even beauty wasn't enough to pacify him. Once again, the song on the wall pulled him like an artistic magnet . . .

*Today, they still remain partners,
The Captain and the man of the deep,
And all the other sea-merchants
Have to read of our profits and weep.
The Captain still doesn't
take chances, oh no,
He says, "Chances can
lead you to grief.
But sometimes you've just
got to gamble, my son,
No matter what you believe."*

So far, the lyrics had steered him perfectly, but he'd stopped short of reaching the implied harbor. Should he follow the entire chart? Did he dare? Moelqai had promised to protect the ship, not its captain. Elija couldn't even make the overture without putting himself in the Detan's power. . . .

Still, surely the promise matched the risk! He might never again get such a chance. But before he rushed in where only an Angel wouldn't fear to tread, he damn well needed some idea of what reefs and shoals he might encounter.

Consider everything you've observed about the Deta, he told himself,

and draw your best conclusions. Then start praying. . . .

"Have you returned to gloat, Cautless, or have you new commands for me?" The Conductor was standing, but his glorious wings hung limply.

"Neither, Mr. Moelqai, only a request: can you arrange for us to have a private talk? Completely private?"

The Angel inspected Elija. "Why should I agree to do so? This vessel is in no danger."

"I'll pay you for it. Remember, not only have I won a free voyage, but you owe over twenty-three deeds from our first game."

"You are adroit at applying degaussing fields to my wounds! How much are you offering?"

"All twenty-three-plus deeds."

"That's . . . generous. When would you care to have this tête-à-tête?"

"Now."

"The bribe appeals. Your Alpha Ballroom has sufficiently high ceilings and I will guarantee we are undisturbed."

Elija blinked. He and the Angel were standing on a vast parquet floor, a jigsaw puzzle of interlocking fish in four contrasting hardwoods. The ballroom was almost empty at this hour, but several workers were putting extra shine on the starboard bulkhead's brightwork. The startled crewmembers gawked, then hurriedly returned to business at the Angel's glare. They seemed too distant to listen in, but Moelqai had promised certainty.

The abundant space allowed him to stretch his wings, which expanded to twenty-five feet on either side. Elija felt a cold blast as the iridescent pinions whitened with rime.

The air darkened. In a heartbeat, a shell of gray mist surrounded the two of them. Elija wondered what the workers were seeing. A vague gray sphere with icy wings protruding?

"Now, Captain, we are secluded." The deep voice resonated as if they

stood in a small, enclosed space.

"Cari?" Elija called and nodded his head in satisfaction when the integration failed to respond.

Moelqai stared at the captain. "You wanted your synthetic assistant barred from our conversation?"

"Cari has one limitation: she can't forget anything."

"Suddenly, this becomes interesting! I take it you wish to conceal something from your masters?"

Elija shrugged. "First, a simple question: what's *wrong* with you? The Angels I've met have all been obnoxious, but *you've* been insufferable."

"Captain! Are you actually showing emotion?"

"Do you actually care? Look, I've suspected other Conductors of padding expenses, but you put mere . . . pettiness to shame. Creating your own emergencies, and then overcharging for them! Watertitans don't forget to migrate. And big as they are, I doubt one could throw a wonderliner ten yards!"

Authority gathered behind the huge dark eyes, Elija's skin prickled with both fear and static electricity; but the great wings shivered and the force grounded itself harmlessly in a shower of blue sparks leaping from feathers to floor.

"You called this conference simply to berate me?" Moelqai asked incredulously.

"Hardly. I just think it's high time we both put all our cards on the table."

The Angel emitted something like a sigh. "Another kind of game? Then we shall again follow your formalities and sit." With a mini thunderclap of dislodged air, two chairs appeared; one was the oversized throne Moelqai had used in Delta Casino.

Dear God! Elija thought, I don't know why, but seeing him pull things through another universe to position them in this one intimidates me more than when he transports the entire

ship! What am I playing with?

The Angel practically dropped into his seat, but Elija lowered himself with a show of calm control. The feat would've been easier if he hadn't felt so much like a man prodding a beehive with a bare finger. . . .

"What cards are you holding, Captain?"

Elija took a deep breath. "I have issues concerning the way the owners are treating you Deta."

"You have gained my full attention. Tell me more."

"Agreed, provided you explain all your trumped-up emergencies."

Silence stretched out so long that Elija began to worry that his plan was already dead in the water. "I'll sweeten the pot," he urged, "and tell you up front how I pulled off that first card trick. . . ."

The Angel stirred. "Do so."

"You saw that virtual chart. On this ship, Cari can make solid-looking images appear anywhere and of any reasonable size."

"Ah! It covered the cards I was so carefully arranging with images of other cards."

"Only the jacks and fives to cover all possible straights. I assumed you'd get to straight flushes eventually."

"So that accursed jack of clubs was the card beneath my jack of spades! Your engine simply dropped the illusion."

"Right."

"What if my card had been the jack of hearts, which *you* appeared to be holding?"

Elija smiled. "My wife figured that not only would you plan to beat my straight with a higher version, but that you'd make our hands opposite colors. She thought your . . . personality would demand the contrast. So Cari switched clubs for spades and hearts for diamonds and would've warned me if Elenor's guess was wrong."

"I never checked *your* hand!"

To the captain's surprise, the Angel began emitting a huffing sound. Then he was shocked when it dawned on him that the ultra-alien was laughing.

"Ah, Captain! In all the vast history of this pan-cosmic expression, have two such rascals ever sat down together and worked so valiantly to swindle each other?"

Elija fought off an urge to giggle hysterically. "Considering the eons involved, it seems likely."

"I'd bet against it. On second thought, I wouldn't. I have learned a hard lesson and shall never bet against you again!"

"Care to place a small wager on that, Mr. Moelqai? Well, if betting is out, perhaps explaining is in?"

Silence.

Elija tried to ignore the sweat oozing from his forehead. He had to either give up, or take an even bigger chance by revealing his new deductions. What would happen if Moelqai decided that the annoying human knew too much?

"I'll meet you halfway," the captain said quietly, "and offer my own insights."

Silence.

Elija wondered where his courage was hiding and longed to go search for it, preferable someplace far away. "From my viewpoint, two things about you Deta stand out: your natural powers and, frankly, that you hold the patent on arrogance."

Moelqai said nothing but his eyes burned brighter.

"It occurred to me that an evolutionary mechanism might connect both observations. In a culture where *everyone* around you has the capacity to rearrange your world to suit themselves, you might need a massive ego just to keep your share of control."

Elija shook his head in wonder. "Survival of the proudest! Am I anywhere near the mark?"

Still no response.

"But as population grows and civilization ramifies, how do you govern a society of intensely self-centered individuals? How do you settle disputes, or organize joint efforts for large-scale emergencies?"

At last the Angel reacted. "How?"

"Perhaps you couldn't . . . if all Deta were created equal. I expect that progressively more powerful Deta occupy progressively more important positions in your culture—a tyranny of demigods, if you will.

"From the moment we met, I suspected you were two steps beyond our previous Conductors—and not just because you can look like a Greek god. You're not an Angel, you're a damn Archangel."

A new, colder, tension was building. "If so," the ultra-alien said in a flat tone, "what would that tell you?"

Elija had to force each word out. "Since you're not earning any more thulium on this cruise than the run-of-the-mill Angel, you're here for another reason."

The Detan seemed larger now. "Such as?"

"I don't know, but it clearly involves human beings, so I suspect—"

"Why humans?"

The captain spread his hands. "Why else would you surround yourself with thousands of us? Because you enjoy our company so much?"

"A valid point. Then what is it you suspect?"

"That Angels have been . . . harvesting something other than lanthanides on these expeditions all along. I've never quite swallowed your story that we're your only source of thulium."

The misty sphere around them was thinning; Elija could dimly see the neon rainbow outlining the ballroom stage. Perhaps Moelqai's concentration had slipped. . . .

"Explain."

"Variations between realities *have* to be minor. Alter, oh, the weak force

even a little, and I don't know what you'd get, but it wouldn't be a universe. So the idea that thulium only occurs in one universe is absurd. And even if we were truly the only game in town, with your powers you could collect gold or platinum in some convenient reality and simply buy all the minerals from us you could want."

Abruptly, the mist turned almost solid. Moelqai shook his wings, creating a temporary miniature blizzard. For one disconcerting moment, Elija wondered if he'd been magically encapsulated inside Elenor's "Vermont Christmas" paperweight—only the snow wasn't tiny pieces of plastic, and the tree's capping angel had swollen to monstrous proportions. . . .

"I am uncertain whether you are a brave man," Moelqai stated, "or a foolish one, but you are certainly too clever. As you requested, no one can observe us in this cocoon. I can provide you a fatal heart attack and no human could prove it was my doing. . . ."

Elija felt he was scared enough to have a heart attack without outside assistance. Why had he risked so much without at least warning Elenor? He tried to dredge up her voice saying something encouraging, but for once his memory failed.

"... perhaps a stroke," the Angel muttered. "Goodbye, Captain."

"Wait! If you kill me now, you may never learn what I have to tell you about the owners."

Moelqai paused. "True. I will hold your death in reserve."

"Since that's your option," Elija said carefully, "why keep secrets?"

"Why share them?"

"Share yours and I'll share mine."

"A worthy motive, I suppose. Very well, I underestimated you earlier; perhaps I shouldn't underestimate your secrets. What would you care to learn?"

"Some facts. Is Earth's universe really dangerous for you?"

"Deadly. Too much interference."

Elija's confidence took another nosedive; he'd expected the opposite answer. Try again, he told himself. "Was I was right about you being an Archangel?"

"An oversimplification, but disagreeably acute. I took on this tedious role to see if a Great One such as myself could absorb more—"

"So you *don't* need thulium!"

Moelqai scowled. "There you're wrong and it *is* difficult for us to procure. But that isn't our only need and these cruises elegantly fulfill all requirements to reach our goal."

"What goal?"

"We've already told humans that much: to preserve a star. Our native star."

"For its sentimental value? Surely, you Deta could just move to another solar system?"

"You speak like a fool, Cauless! If our star explodes, it will destroy our home world and without our planet's unique electromagnetic attributes, Detan children cannot develop properly. Like you, we are in thrall to our own evolution. Here is something you will never tell another human: our species hovers on the threshold of extinction."

The captain stared at the alien. The stakes here were far higher than he'd thought. "What danger," he asked softly, "could threaten a world of *Angels*?"

"My people travel between universes using our extrusions; Nemes and others do likewise with machines. Such transitions can, very rarely, occur naturally. Our sun has developed an instability that will soon open a gateway to a realm of contrary elements—"

"Antimatter?"

"I am no student of trivia. Soon, even as you measure intervals, our planetary system and more will disintegrate in a gamma holocaust."

"How can thulium help?"

Moelqai hesitated. "Even combined, the talents of my species cannot heal our star. Therefore Nemes have offered to build an engine for the purpose—for a price that does not concern you. We Deta are unfamiliar with such toys. We've never needed them."

Elija sensed how hard it was for the Angel to confess any incompetence. "So the machine uses thulium?"

"Obviously. Neme engineers prattle of creating a magnetic field of fabulous potency. My people, however, will need to emplace this engine deep within our star and protect it until its task is done. Do you have any idea what a challenge that presents?"

"No."

"We are not immune to charged particles! We cannot approach our sun closely, so we will need to link our fields, millions of us, to gain sufficient reach."

"Is that possible?"

"Yes, but a problem arises. Our consciousness is naturally centered in our local nodes. We can make any other part of ourselves almost equally aware, but the farther it is from our local node, the more effort is required."

"I'm starting to see. You're talking about combining Detan force fields to make a kind of giant extension arm. But as that arm grows longer, it will get . . . numb, harder to control."

Moelqai nodded, almost approvingly. "Impossible to control without a degree of external stimulation."

"How can my kind help you with this?"

Small sparks leapt between the Angel's fingers. "I wouldn't tell you if I didn't hold your fate in my wings: humans can energize Detan bodies to a much wider awareness."

"How?"

The Angel considered for a moment. "Those tubular decorations at the end of this room. Why do they glow?"

"The neon lights? You want a sci-

ence lesson *now*?"

Moelqai just waited.

"All right. The glass is filled with inert gasses—usually neon, argon, or krypton—and capped with electrodes on both ends. When high voltage is applied to the gas, it excites the—"

"Enough. Human beings provide the voltage we require. And although each cruise, theoretically, only supplies enough voltage to adequately charge a single Detan, that Detan can return home to distribute the charge among several hundred others. I'd hoped that one such as myself would hold a greater charge."

"But why humans specifically?"

"You know that I am far larger than I appear. My essence permeates your vessel including the space occupied by human bodies. Your nervous systems operate on just the right—perhaps the term is "wavelength?"—to stimulate our extremities to greater awareness."

"Quite a coincidence," Elija said dubiously.

"Not at all. The Nemes were seeking a species with exactly such a property on our behalf. They were the ones who suggested the idea of wonderliners."

"And this stimulation happens automatically?"

"No. Humans themselves must be excited by adventure, or sex, or pleasure, or pure novelty. You see? These cruises can easily combine all four! But I have observed something your previous Conductors were too insensitive to perceive: the strongest result by far comes when a human attempts to manipulate objects at a distance."

Elija frowned. "Why would we try? We don't have your powers."

"Human motives do not concern me. I can tell you where it most often occurs: in your casinos."

"I see." How many times had the captain witnessed some high roller leaning over the craps table, every

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muscle tense. . . ?

"Are you satisfied yet? I am ready to hear your secrets."

Press on, Elija told himself, don't stop to smell the thorns. "Two more points I need cleared up first. Does, um, exciting your inert gasses hurt humans in any way?"

"No. And the final point? I grow impatient."

"Why the hell so many fake emergencies? Sounds as if you Deta need these cruises desperately. If this one were cut short or we never made it home, that would probably end the whole business."

Moelqai was silent for a moment. "Some things should not be revealed to inferiors."

"I promise you," Elija said as calmly as possible, "you want the information I have. And don't forget, you'll have the option of . . . erasing any embarrassment."

"True. My manipulations were necessary. Humans on this tour were generating far more stimulation than I'd been led to expect. *Too much* of me had awoken; force fields only intended as raw material for repair functions were independently absorbing those energies we Deta use as food. I was bloated with power and had to keep releasing the excess in large bursts or perish—I will soon need to do so again. I invented so many excuses for wasting energy, I came to fear you would guess my dilemma."

"What if I did?"

"Disaster. If the owners learn what we are gaining from humans, they will surely reduce their thulium payments. We cannot afford the least reduction; we are gathering minerals too slowly as is."

"So you decided to end the cruise early and risk the entire arrangement?"

"Where was my choice? If I had perished, so would you. All I could do was put my local node in the heaviest flows of power and seek a way to

staunch the flood."

"So that's why you homesteaded our casinos! And I can guess what caused your overload: the owners installed extra roulette wheels this trip. That's one game where a gambler would instinctively try telekinesis."

"Ah. Again you surprise me. I really will regret ending your life."

"Then don't."

"Captain, I have heard a human adage: confession is good for the soul. But for me, this session has only rankled. Speak to me of your masters and then prepare for death."

Do this right! Elija told himself. Everything is riding on it. If I fail, Elenor will never forgive me.

"Your actions make sense to me now, Moelqai, given your attitudes. What doesn't make sense is your attitudes. And, frankly, it's just pathetic that you thought you were being so clever by making a double profit on wondercruises."

Moelqai stiffened. "Only a fool could miss the genius of the scheme."

"One trouble with pride is that it's blinding. Another is that it's usually self-justifying."

"You deny that our pride is vindicated?"

"Depends on how you cook the books. You Deta are stronger than humans—physically stronger and equipped with abilities we can't begin to match. Focusing on those superiorities you can hold us in contempt with—hell, with both wings tied behind your back."

"Name another basis of comparison!"

"Shall we compare mechanical skills? Artistic skills? How about plain social skills? We may be weak and short-lived and petty in many ways, but I'll tell you something about your own species: your contempt toward us has cost you. You've studied our facial expressions well enough to mimic them—probably just so that you'd

know how we were reacting to you—and you've mastered at least one human language. But those things are only the human *vener* and you've never thought to look deeper. Your ignorance has left you vulnerable. Ever since wondercruises began, the owners have been paying you so little for your work, it hasn't even scratched the dust on the surface of their profits!"

"This is true?" Moelqai snarled. "I was told that thulium is very rare and most difficult to refine."

"Not quite. Geologically, it's reasonably common on Earth, but I admit that it doesn't aggregate conveniently. So we mine monazite, which contains enough thulium for ion-exchange techniques to make it practical to extract. Per ounce today, in metal form, it costs no more than gold. You've been had."

Blue flames burst from the semblance of human eyes, leaving momentary holes that exposed blazing emerald facets beneath.

Elija was suddenly too furious to be afraid. "I wouldn't get so damn hot-headed if I were you! Your intent has always been to exploit *us*, and when you wound up in trouble, you were too arrogant to ask for a little help."

The human eyes reappeared, but the air chilled even further. "I do not require help from inferiors. And as I stated, I didn't wish the owners—"

"And as *I* stated, you don't understand humans. You haven't bothered to try. Metacosmic employs me, Moelqai, it doesn't *own* me. Saving your species is as worthy a goal as I can imagine and I would've kept your secrets if you'd trusted me. Perhaps someone so faithless *can't* trust anyone else. If I hadn't won our contest, weren't you prepared to abandon the ship and leave everyone on board to die? What kind of monster are you?"

Moelqai lowered his gaze. "Not the kind you think. I only wanted to pres-

sure you to ask me to return the vessel. Once the cruise was over, I was sure our Neme agent could reach some settlement with Metacosmic. A Neme trader can talk your feathers off! But I am baffled by *your* motivations, Captain. Why risk livelihood and your life by revealing the avarice of your employers?"

Elija braced himself for a final tack. "I despise their ethics; it upsets my sense of order. And I see far grander possibilities in a collaboration between human and Deta than amusing the rich and lining the owners' pockets."

"Such as?"

"For openers, getting you the thulium you need in one quick lump; you obviously have no idea how lucrative these little excursions are. As to your other need, why can't we set up a full-scale casino in some handy universe? We could invent a dozen variations on roulette. Then, after your world is safe, I have other notions you might consider."

"Perhaps you have some avarice of your own?"

"Certainly, but not just for money. With human engineering and your powers, think of the places we could go, the things we could learn! And talk about profits! We could open up trade routes that would—but I'm getting ahead of myself."

The Angel brooded. "Are you suggesting that Deta stop working for your masters and begin working for *you*?"

"By no means."

"Then what arrangement have you in mind?"

"Another time, remind me to tell you about my favorite song. Or am I out of time? Before we continue, I need to know." Elija couldn't quite keep his voice steady. "No sense talking 'arrangements' with corpses."

Moelqai was quiet for a long moment. "You have complicated my deci-

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sion. I think you are a dangerous creature in your fashion, but too valuable to, ah, waste. *If* we can agree on what we tell others."

The captain felt relief flowing through his body like a tidal wave. He could keep his mouth closed all right! He hadn't the slightest urge to tell Moelqai that the Angel had lost that fi-

nal hand on a bluff. . . .

"Two crooks such as us," Elija said, "should have no trouble keeping secrets. As to our arrangement, we have a useful concept on Earth that I'm sure you'll find alien at first, but which has many pleasing advantages. I'll explain it in detail. It's known as a 'partnership.'" ■

IN TIMES TO COME

Michael A. Burstein leads off our September issue with "Sanctuary," a tense novella about the kind of problem that can arise when two very different cultures are forced into a high-stakes interaction. What do you do—and what do "they" do—when a refugee from one group's version of justice seeks protection under the auspices of another culture's most deeply established institutions? Especially when both cultures' principles are based on long and careful consideration of their people's nature and needs—but those natures and needs are themselves quite different? To paraphrase the old saw, one man's basic need may be another's abomination. . . .

Meteorologist Kevin Walsh offers an unusual fact article, "Water World, Glacier World, Dust World," using computer simulations to survey the wide range of "terrestrial" worlds that might result from slightly different values of basic astronomical parameters. And we'll have a wide variety of stories by such writers as Grey Rollins, Larry Niven, Kevin J. Anderson, Carl Frederick, and Jerry Olton.

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Mission to Utah: A Science Fiction Writer's Adventures at the Mars Society Desert Research Station

Wil McCarthy

A former aerospace engineer and contributing editor for Wired, Wil McCarthy is the author of the acclaimed nonfiction book Hacking Matter, as well as eight science fiction novels including the New York Times Notable Bloom, Amazon.com "Best of Y2K" The Collapsium and, most recently, To Crush The Moon.

Prologue: Off Course and Loving It

Even before their first contact with Western societies, the Polynesian people were the best navigators in the world. They understood the sea and sky far better than the Greeks or Romans, and without compasses, sextants, or naval chronometers they could nail down their position as precisely as any pre-GPS sailors ever have. Arguably, their conquest of the oceans was limited only by the agricultural and mineral poverty of their tiny nations; if they'd had access to coal and bronze and vast

plains of wheat, we might all be speaking Hawaiian right now.

One of the tricks they used—one of many—is so simple it sounds like a joke: they looked at the bottoms of the clouds to see what colors they were reflecting. It turns out that clouds over the open ocean are distinctly blue, while those over tropical islands take on a distinctly greenish or yellowish tinge. And while I never know how much credence to give such anecdotal down-home wisdom, I can tell you first-hand that Hanksville, Utah is visible—indeed, unmistakable—from hundreds of miles away, because the clouds floating over it are brick-red on the bottom. No kidding.

I was heading there with a group of talented people, on a simulated Mars mission privately funded through the dogged efforts of the Mars Society. I was the mission journalist, selected in part because the Mars Society likes publicity and appreciates experienced



The road to Hanksville.

writers. But I'm also an aerospace engineer who knows how to fix things, and I'm closely acquainted with the people who built the phony (er, simulated) Mars base out there in the empty desert west of Hanksville. In a crew of six, I alone had not volunteered for the mission. I was a draftee.

I was also the executive officer of a geographically scattered crew whose commander was struck down by a mysterious (and fortunately brief) illness, and whose foreign contingent was consequently stranded at an airport hotel in Salt Lake City, five hours from the MDRS facility. Eventually, with a lot of driving, we managed to pull everyone together and start playing—er, working—out there at the base. But my narrative properly begins on the evening of Day 3, when I finally had the time, clarity, and AC power to plug in my laptop and peck out the following words . . .

Day 3: Touchdown

Tired? Me? Having taken on the responsibility of the morning generator refill, I found I had a really hard time sleeping, for fear that 6 AM had arrived or because the sound of the generator had changed slightly. However, I found myself dreaming very intensely in short bursts, sometimes even when I didn't even feel fully asleep. I guessed I was starved for REM, even more than for physical rest.

Anyway, there we were on the simulated Mars outside of Hanksville, Utah, late getting started but finally beginning to move forward. The terrain was amazingly Marslike, with only the occasional tuft of grass to prove this really was Earth. Oh, sure, there was also the blue sky and the intense sunlight, but the human eye works on a logarithmic scale—a 10x reduction in actual illumination results in a perception of “half as bright.” The sunlight at Mars is only $\frac{1}{4}$ as bright as on Earth,

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but it would *look* like about 80%—not much different at all. Standing on the daylit surface or looking out through a hab window, you would not see the kind of dim, cartoony, special-effecty Mars they show on TV and in movies, but a very real landscape of dirt and rocks, hills and formations. Just like this, or nearly. By the light of the stars on a moonless night, the illusion is even more convincing!

So if first impressions matter, this Mars was off to a good start. Our first view of the habitat was appropriately striking against the afternoon sky; the thing is designed to look like a landing craft, complete with shock-absorbing legs, fore and aft airlocks, and a nest of antennae poking out the top that would melt the boyish heart of even the most jaded reporter. Wow. Upon entering I amused myself by looking out the windows and trying to believe there was no air out there. Or rather, not enough to breathe. In this red, lifeless landscape, it didn't require any great stretch of the imagination.

But it wasn't time to settle in. Handover of the facility from Crew 26 to Crew 27—us—was complicated by one of our crew coming down with a 24-hour illness, and by a host of transportation problems, so that half our crew ended up camping out on the cold habitat floor, while the old crew slept in their bunks and two of ours slept soundly in a hotel in Salt Lake City. But eventually we got the old crew safely back to the SLC airport and the rest of our crew safely down to the hab.

One of the most interesting (and truthfully, intimidating) things about the handover was watching the old crew, not only in action but also at leisure. Not that there's too terribly much leisure here, and I don't want to imply that everyone in Crew 26 got along with everyone else 100% of the time. We're all human beings. Still, there was a definite rapport there—

every person had a task and every task had a person, and it all seemed to flow very easily. Cooking, cleaning, managing the power systems, operating the pumps and valves . . . After two weeks together, they were laid back and very tired, not taking things too seriously, and yet getting an awful lot of work done. Here was something for us to aspire to, now that we were alone and isolated.

And we really were isolated; the only link to the outside world here is satellite internet. Email and web, baby. If you've got a question, you'll wait at least 45 minutes for the reply.

Still, frustratingly, by Day 3 we were still doing training and setup. Testing radios in the morning and then, after organizational meetings and lunch, we messed around a bit with the spacesuits and ATVs—not “in sim” (actually pretending to be on Mars) but just to familiarize ourselves. We also had a request from Mission Support to move our main diesel generator 10 feet, so it would sit behind a manmade rock wall instead of in front of it. There it would be quieter, and wouldn't spoil the view. Who could have guessed this would mushroom into a three-and-a-half-hour task for six people?

As it turned out, the little rain shelter protecting the generator was anchored in solid rock. Working it loose, and then devising a new means to anchor it in the rock-hard soil on the other side, turned out to be a really involved, creative process. Under the hot Utah sun, in our t-shirts and ball caps, we didn't feel much like astronauts. That was the frustrating part. Still, we got the job done, and even spared half an hour before sunset to pretty up the platform with a welcome mat and some stapled-on plastic sheeting. And as we high-fived each other and photographed the completed job site, I felt like we were starting to build a bit of that same rapport we'd seen in the old crew on Days 1



The area around the Mars Society Desert Research Station really does look like Mars.

and 2.

And with the aforementioned internet access, and a dinner of salmon and rice, we weren't exactly roughing it. So began our adventure on "Mars."

Day 4: On the Subject of Cheesiness . . .

Life is what you make it, and simulated Mars missions are no exception. It's possible on the one hand to treat this whole exercise as a joke—grown men and women dressing up and play-acting. On the other extreme, some participants have been known to get really, really serious about the simulation, making unnecessary problems for themselves and others. But there's a middle road where common sense prevails, where hard work and serious intentions combine with a playful sense of discovery.

To make an imperfect analogy, flight simulators are not "fake flying." They're not real flying either, and as

such they're neither pointless nor joyless. What they are is a training tool, which millions of people have used to familiarize themselves with the mechanics of flight. Microsoft Flight Simulator won't make a pilot out of you, but if you try it out and (a) don't like it, or (b) can't handle it, then this is a clue that you're not really cut out to be a pilot. Conversely, if you master the sim and find its little details thrilling rather than tedious, then you probably do have the Right Stuff, and can expect a better-than-average time at a real flight school somewhere.

So. The way I saw it, this expedition was not so much a fake Mars mission as a genuine training exercise. Most of us there at the hab would probably never go to Mars for real, but that didn't make the training any less valid. Like many of the "useless" classes we took in school, the experience helps shape our viewpoint and our understanding of the wider universe. It en-

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riches us as people. After just four days in this desert, I'd added dozens of useful skills to my self-reliance tool kit, and we hadn't even started the sim!

Our commander, Alejandro Diaz, is a Boeing engineer who works closely with the astronauts on the Space Shuttle and Space Station programs. And following his lead, we were shaping up to be a cautious and methodical crew. On Day 4 there was still no full-dress "extravehicular activity," or EVA. Instead, we worked our way toward it with a sort of "practice sim" or "simulated sim," where we went out without space suits. There's nothing cheesy about this, either; real astronauts don't go to space until they've rehearsed their mission in water tanks, and they don't enter the tanks until they've walked through the steps in a dry mockup, and they don't even do that until they've been thoroughly trained and briefed on the mission's equipment and objectives.

Step by step, we inched our way toward realism, starting with a test of the base's long-range remote radio—which wasn't working and would clearly need to be serviced. We also mucked around with battery chargers and microphone headsets, and cleaned things up in the Green Hab, which is connected to the habitat structure and processes our wastewater through plastic filters and five different baths of algae and bacteria.

Later on in the afternoon, we did several hours of navigation exercises with maps, compasses, and GPS. Arguably, the compass is not a realistic piece of simulation hardware, since Mars doesn't have a planetary magnetic field like Earth's. However, there are several strong regional fields generated by magnetic materials in the planet's crust, and any future Mars astronauts would be silly not to use them as nav aids. Believe it or not, the GPS actually is realistic, since the Mars Global Surveyor and several other satellites in

orbit around the planet have been equipped with GPS-like clocks and radio transmitters. Accuracy is not great right now, but as more and more spacecraft arrive at the planet, the system can only improve. By the time we start landing astronauts there, they should have little trouble finding their way.

Anyway, by some strange coincidence three members of our six-person crew were born in New Jersey and now live in Colorado. Ph.D. aerospace engineering student Jim Russell and jack-of-many-trades Bill Foltyn are both hardcore backpackers, and as a Colorado near-native and former boy scout, I've spent a bit of time in the wilderness myself. Alex Diaz, who moved from Peru to Los Angeles at the age of 10, had limited hiking experience, and our British colleagues had none at all. But with a few hours of training and appropriate team assignments, there was little doubt they'd do well.

The exercise was another practice EVA: a two-hour hike, sans spacesuits, where we deliberately got ourselves mildly lost and asked the trainees to navigate us back to the hab. Not only was the exercise successful, but it also took us through some of the most striking terrain I've ever seen. Not all of it looks exactly like Mars, but it all certainly appears to be an alien world of some sort. We made several weird discoveries along the way: natural caves and odd spiral-shaped imprints in the rock. Fossils? The hills are covered in rubble on their northern faces, while on the south they're just stripey mounds of bare dirt. We did a lot of speculation about this, and Bill (our geologist, among other things) was in hog heaven, dashing from rock to rock in great excitement, or else plopping himself down on the ground to stare at one spot for minutes at a time.

In an environment like this, it's hard not to be a scientist. Why does it look



With help of a crewmate, science fiction writer Wil McCarthy is fitted into his space suit.

like that? How did it get that way? Obviously, this area had been studied by geologists before and is probably well understood. We're not really adding to the sum total of human knowledge. But we're learning the art of exploration, and more importantly, the art of making that exploration meaningful.

Day 5: Inside, Outside

Sometimes you have to backtrack in order to move forward. We had a great day here, but a few things got messed up that were basically a hundred percent my fault.

The previous crew had told us that the hab's remote radio wasn't working, and our naive testing confirmed their finding. The problem was, there was a remote radio control panel, which they didn't tell us about, because the crew before them (Crew 25, known locally as "that party-crew") didn't tell them. In fact, the panel was

hidden under a pile of junk, and from looking at the radio installation itself and reading the Mission Support comments about it, I got the impression that several crews had gone out to inspect it this season, tweaking and modifying it in a semi-clueless effort to get it working, while the controls lay hidden in (nearly) plain sight.

But I had an inside edge; I knew the guys who designed the system, and they emailed me a document which explained its design and operation in considerable detail. But I didn't read it carefully enough, or didn't quite parse what I was reading, and as a result we may have cut down a perfectly operational radio this morning for "servicing" inside the hab. Sigh.

But I'm getting ahead of myself. Breakfast was a time of high excitement on the morning of Day 5, because we were finally "in sim." As far as we were concerned, there was no air outside the hab, and stepping out

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the door would kill us. After a quick meal and an even quicker organizational meeting, we all went downstairs to try on our space suits.

There were six suits and six of us, so we had to find the best match between garment and wearer. Each suit had a numeral on it, and a Velcro patch to slap your name tag, and a backpack and helmet with the same numeral. It turned out I was McCARTHY 2, or "EV2" in the radio jargon of simulated space missions. I was no longer quite the same person I'd been when I woke up; for the convenience of my crewmates I had been re-named.

The plan was for all of us to get outside, two at a time, and the first scheduled EVA was for Bill Foltyn and myself to hike up to the remote radio and ascertain what was wrong with it. So when everyone else had hung their suits back up, Bill and I were helped into our backpacks, outfitted with drinking tubes, boots and gloves, radios, and sweat-absorbing headbands. Finally, our helmets were latched in place like pressure cooker lids.

Was it claustrophobic? Not really. The air in the helmet was a bit stuffy at first, but our handlers quickly attached the air hoses and turned the backpacks on, releasing a cool, fresh breeze directly into our faces. But the backpacks were heavy and the chest and waist straps confining, and the helmets did limit our peripheral vision, and within a few minutes we were closed up in the airlock, with the red DECOMPRESSION light glaring down. Twenty minutes to kill while our (simulated) pressure equalized with the (simulated) near-vacuum outside. That makes it worse.

Twenty minutes (though it's actually less than the official safe decompression time on the Space Shuttle and Space Station programs) is a long time to sit around, and until you've had a space helmet on, you don't realize just

how darned often you touch your face. Imagine reading this entire report without scratching or rubbing or stroking your face even once. Does the very thought make you itchy? Well let me assure you, in the sensory deprivation of a two-man airlock, with radio chatter discouraged and only our toolboxes to sit on, I felt itchier than I ever have before. With lots of time to experiment, I managed to identify several rough points on the inside of the helmet where I could rub various parts of my face. Not necessarily the parts that itched, but it was something. It helped. There were the air vents, the bite valve of the drinking tube, and especially the lip of raised plastic between the transparent dome and the latching collar beneath it. Ah. That lip was a lifesaver.

Fortunately, once we got outside and started doing stuff the itchiness quickly subsided. We exited the airlock and started climbing up the ridge behind the hab, where our observatory and Martian flag were located. Right away, I figured out that the airflow into my helmet was constant, regardless of how hard I was working, so as the climb got steeper I began to feel short of breath.

"EV 2 to EV 6," I said to Bill over the radio. "Let's slow it down. The spirit is willing, but the flesh needs oxygen."

"Roger that," said Bill, and from the communications station inside the hab, Alex (here known as "HabCom") chimed in his agreement. This was a thing to be undertaken cautiously—we weren't in any rush. Indeed, this was really an experience we should savor, and we did. The views were staggering enough that we had to keep stopping for pictures—a practice which ended only when my camera declared itself full. Too, the experience of being EVA, being Outside, being fully immersed in the alien environment of the simulation . . . well, it was more intense than this draftee

was expecting. It felt easier and less dangerous than a deep scuba dive, but there was nothing make-believe about it. We really were on a steep hike in the middle of nowhere with heavy loads to carry, with our bodies locked into potentially suffocating suits that we couldn't hope to escape from without help. It was thrilling, it was fun, and it was serious business. The fact that this wasn't Mars seemed beside the point.

From the observatory, we followed the ridgeline up and up, to the steep promontory where the remote radio was mounted. It took us about twenty minutes to get there and another twenty to complete our inspection, the most difficult part being an annotated sketch of the several-times-modified wiring harness running up from the hab and into the radio itself. This was also where I found out just how hard it can be to retrieve a Fischer Space Pen from the bottom of a toolbox with space suit gloves on—a task which consumed two minutes all by itself. Never doubt it: astronauts are immensely patient people.

Anyway, long story short, we verified there was no power in the wires, so we cut the radio down and threw it in one of the toolboxes, then hiked back down the hill. Recompression was *way* more boring than decompression, and once we got inside we geared down and went upstairs for lunch, still unaware of our error. Tomorrow we'll go back up there and undo the damage. To be fair, this sort of hasty refit is realistic for any remote outpost, and so are the communication problems. When your only link to the outside world is via time-lagged satellite mail, it's hard to get the whole story.

Still, the trip wasn't a total bust. While we were up on the promontory we had spotted an anomalous reflection at the base of a nearby butte, named 4679T on our map, or "Phobos

Peak" in the annotations of some previous crew. So after our maintenance debacle, we helped Peter and Julie, our British colleagues, suit up for a hike out there to see what this shiny object might be. It took them half an hour to get out there and half an hour to get back, and once we'd gotten them out of their suits, they showed us the pictures they'd taken, of a large sheet of corrugated plastic, which apparently blew away during the construction of the Green Hab. Mystery solved. And you have to hand it to Pete and Julie, for completing their first-ever solo hike in a genuine wilderness. In space suits!

Alex and Jim went out after that, on a "non-recyclable materials transport" (i.e., putting our trash in a remote dumpster several miles away), and after that it was dinner and dishes and email and reports. At least to this extent we're exactly like real astronauts: fun and games are a tiny fraction of what we actually do out here.

Day 6: The Zen of Decompression

I was feeling better about the radio. After trading dozens of emails with engineers and ground control and past MDRS crew members, it became clear that the system hadn't worked for months, and that it had been modified from any of the past configurations which were known to work. In addition, field measurements showed there must be a break on two of the cable's four internal wires, although a visual inspection of this long, weather-beaten, multiply-spliced monstrosity had failed to reveal it. When I finally got around to opening up the control panel itself, I discovered why: someone had deliberately broken several connections inside the box.

Presumably they had a reason for doing this, but no documentation was left in or near the panel, and there was no clear indication where in this jumble the wires were supposed to con-



Wil McCarthy and Bill Foltyn
prepare to decompress.

nect. Whatever the intention had been, it hadn't resulted in a functional system, so whatever else may have gone wrong, the remote radio was very definitely broken before I got to it. By day's end I still hadn't figured out how to fix it, but there were good reasons for this, which I'm eager to talk about. Simply put, being an astronaut is really, really time-consuming. And that's a good thing.

As the situation unfolded, I made three separate EVAs to inspect the wires, to strip and clip them, to twist and diagnose. It's hard, slow work with a centimeter of stiff padding around your fingers, but that's nothing compared to the effort involved in getting there. The longest of my sorties was about 2 hours and the shortest only 15 minutes, but each one involved 20 full minutes of decompression at the start and 20 more of recom-

pression at the end. That's two solid hours spent staring at the airlock wall—which is infinitely more strenuous than any mountain-climbing feats of reverse engineering.

Still, while it sounds painfully corny, having that kind of time on my hands really did give me a chance to reflect. On my life, on myself, on my approach to the sedentary act of equalizing pressure.

The first EVA of your life is jangly and exciting, but the second is just as difficult and uncomfortable, and nowhere near as rewarding. It's kind of demoralizing, truthfully, as the airlock door slams shut like the bars of a prison cell and the arrow of time—normally rushing you toward old age and death—slows to an agonizing crawl. Some nerve! But by the third time out, you start to develop a rhythm about it. Radio chatter is discouraged, but you find little hobbies and habits to pass the time in the private world of your helmet. You have a sense of how long you'll be there, and what it's going to feel like. As with a lot of things in life, the hardest and most critical decision is to surrender your dreams of comfort. You won't find a good way to sit, a good angle to rest your head, a good corner to scratch your nose on. You can't. It doesn't matter.

It doesn't matter.

For me, this dumb little epiphany brought a sense of genuine peace. I think the Buddha Siddhartha put it best when he said, simply, "Be here now." It's good advice, as pertinent in a twenty-first century airlock as on an ancient rice paddy. Surrender comfort, surrender desire, surrender the future. Just be. Eventually, the airlock will open and a new phase of life will begin.

If I learn nothing else from this expedition, I'll still count myself—however slightly—a wiser man.

WIL MCCARTHY

Day 7: Entropy Day

Nothing lasts forever, and in the noontime sun and freezing nights, the dust and wind and harsh terrain of the “Martian” desert, a lot of things won’t last even one season. This, too, is a lesson we’ll take home with us: time is short, and entropy never sleeps. The story of this place is, as much as anything, a story of Band-Aids and half-measures, of fighting back the tide with a leaf blower.

We were driven inside from a late EVA yesterday afternoon by a genuine Martian dust storm, complete with scouring grit and dry lightning, and the resulting charge in the atmosphere was sufficient to clobber our radio reception and slow our satellite uplink to a crawl. This turned out to be the leading edge of a major storm system that blanketed the sky in gloomy clouds and finally managed, around lunchtime, to dump torrents of Earthly rain on the desert. From the hab windows we could see the water carving new channels in the soil, deepening the trenches and washes that define this canyon country. The desert never sleeps, either.

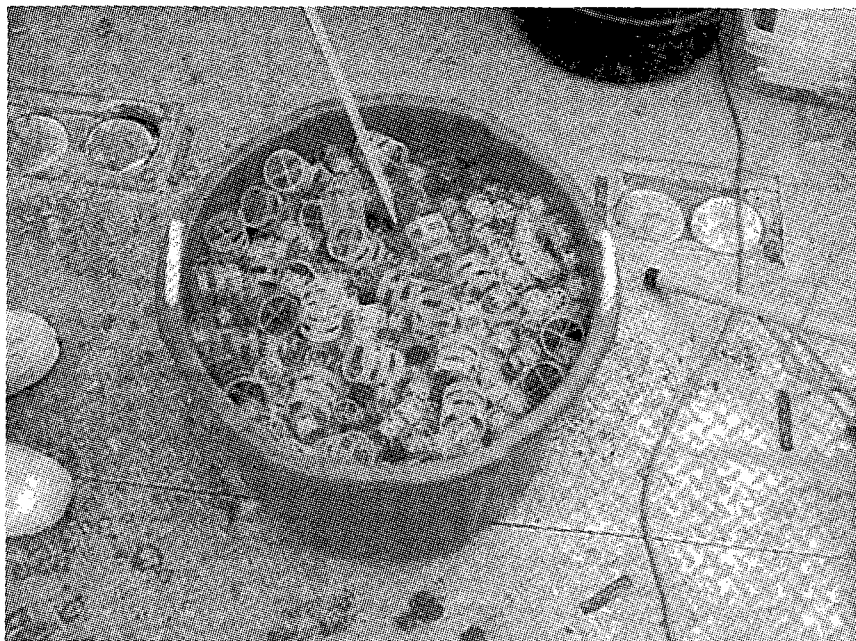
Anyway, this morning’s window of moderate weather was sufficient to get Peter and Julie and Jim out to Phobos Peak again to retrieve the wayward plastic-sheeting they’d found there, and afterward to take a rover ride north along the gully known as Lowell Highway. I’m sure it was beautiful, as everything on Mars seems to be, but along the way Rover 1, which Crew 24 had thoughtfully wrecked for us, sprang a rather ghastly oil leak and started refusing to shift gears. Our gallant astronauts managed to limp it back to the hab and open up the engine for inspection, but the prognosis was not good. It looked like there’d be no more three-rover expeditions for this crew.

Meanwhile, I was inside mucking with the remote radio, which I *finally*

got working on the test bench. As many before me have noted, it’s an iffy design which was never intended to be anything but temporary. I’m frankly astonished it lasted as long as it did, and even in its “repaired” state, it’s sharing a common ground between signal and power, which puts a voltage across the ear bud and causes it to heat up uncomfortably. The TALK button also sticks sometimes, and the only way to release it is to briefly cycle power. But given the ratty four-wire cable for which we have no replacement, this is as good as it gets. If the weather relents, we’ll take the thing up onto Radio Ridge again tomorrow and see how it likes the outdoors. Fingers crossed.

And since the stormy afternoon offered no EVA opportunities, Commander Alex decreed that we would all fill out our psych evaluations—part of a human factors study being performed by an Australian university. That didn’t fill up the whole day, so I rather shockingly managed to fall asleep for 15 minutes in the midst of my colleagues’ cabin-fevered antics. And then, with my alternatives exhausted, I was forced to look to my actual job, not as mission journalist, but as, you know, a journalist. I cranked out my monthly column for the SciFi Channel. Frankly, it felt weird to be answering to an Earthly power other than Mission Support. I hadn’t been following the news at all. What possible relevance could it have out here?

I’d clearly crossed a threshold of sorts; the Martian desert didn’t feel like home yet—I’d seen it mainly at a distance, on radio repair missions—but the hab itself was as cozy as an old bathrobe, and I think we all felt a definite sense of ownership, rather than mere occupancy. There are problems here, yes, but they’re *our* problems, to fix or to live with. Earth may begin at Hanksville, barely six miles away, but even so, it’s a whole other world.



In a solution of bleach and water, the author washes algae off the water purification system's "bio balls."

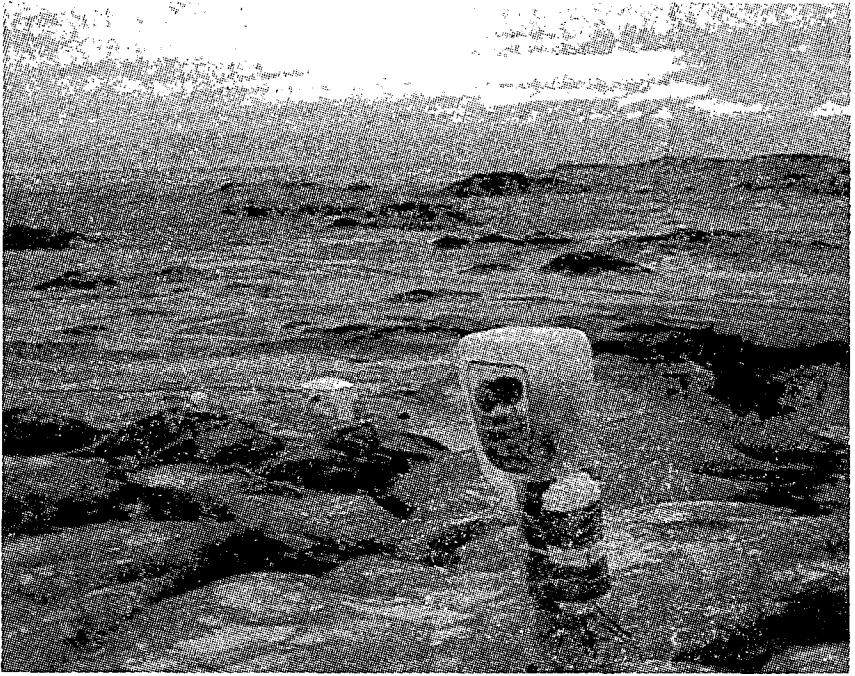
Day 8: Climbing the Walls

One of the functions of weather is to remind us about the indoor chores we've been neglecting. Today was no exception, as rain and mud once again scuttled our EVA plans, forcing us to spend the morning on psych evaluations. Psych is one of those irritating activities that real astronauts have to put up with constantly. How do extreme environments affect motor skills, or short-term memory, or your opinions about your crewmates and life in general? The skill tests make you feel stupid, and the questionnaires are phrased in confining ways, so you end up feeling not only vaguely insulted, but also forced to give a skewed account of yourself.

"How eager are you to leave this mission? Very, Somewhat, or Not At All?" There's no space to write in, "I'm having a blast, but I miss my wife and kids and there's a mountain of work

piling up at home." There's no way to tell the test that the days are weirdly long here, and the weeks weirdly short. Is it Day 8 already? Really? And remember the conversation we had the other day? It was two hours ago. The data that psych collects may fit nicely into their graphs and theories, but I'm here to tell you there's something essential and important about the experience that they're failing to capture. Extreme environments are about more than just reaction time. They get inside you.

Which is why we had mixed feelings when Day 7's rain continued off and on throughout the night, leaving the ground two inches deep in slimy mud. This desert doesn't lack for rain—not in the spring, anyway—but it lacks absorbency. The water forms a layer of wet clay at the surface that acts like a carpet of Saran Wrap, locking out any deeper soaking. Any addi-



The remote radio station on Radio Ridge, overlooking the MDRS habitat.

tional moisture just rolls off. Mud oozes and slides, burying seeds and animal burrows, keeping the landscape lifeless. Which is good for purposes of the Mars Society, except that we'd really like to get outside and *explore* the landscape.

Our plan—not a silly one as such things go—was to let the morning sun and wind dry the soil back into a hard crust, so we could finally, finally EVA back up to the ridge and put the remote radio back in service. But just as we were finishing lunch, another squall line swept in from the southeast like a wall of hard rain, and the weather report was calling for “scattered showers” from here on out. Damn.

To pass the time, Bill and Alex repaired Backpack 6, while Julie experimented with the Crock-Pot and bread machine and Peter cultured wastewater samples downstairs in the lab. As for myself, I spent the afternoon

helping Jim in the Green Hab, an area where I'd previously spent very little time.

Jim Russell is a walking contradiction—a former lifeguard and avid surfer/skier who likes things sanitary. But he also likes sewage. A lot. With half an invitation, Jim will talk your ear off about suspended solids and anaerobic bacteria, not because he's a bore, but because his generous nature compels him to share all the best of what he has. Day after day, Jim expresses a serious concern that he's hogging all the sewage duty, keeping the rest of us from getting elbow deep in the slime tanks and really *feeling* what wastewater treatment is all about. You've got to love this guy.

So anyway, yeah, I figured this was probably a good day to try my hand at one bit of MDRS I knew nothing about. Unfortunately, the Green Hab was sick, and it reeked. Jim didn't

mind the smell, but complained that it wasn't the *right* smell, because the tanks and filters all had open tops, and the light that fell on them was encouraging algae growth. And algae are bad. In theory they produce oxygen, but they also float, and like mud they form an impenetrable slime, which prevents the tank water from interacting with the air above it. So our chore for the day was to scoop all the "bio balls" (plastic cat-toy-like objects of high surface area) out of the trickling filters and wash them in a solution of clean water and bleach, so the tanks could start clean when Jim turned the system back on with lightproof covers in place. Being resourceful explorers on a limited budget, we used garbage bags. With any luck, the light-starved algae would die off quickly, giving Peter Collins' bacterial cultures a chance to thrive when he poured them back into the filters.

There's a life-lesson buried somewhere in this experience, or maybe an off-color joke, but as afternoon gave way to evening, I was just feeling sleepy and dull, and decided to read a tool catalog I found in the bookshelf. Not everything has to be deeply meaningful.

Day 9: Living the Dream

Do you ever have one of those times when a really keen observation pops into your head that you'd like to include in a daily report, but by the time you get to the report, you've forgotten it? You'll just have to take my word on this, I'm afraid, because after a long day of hiking, four-wheeling, and electronic diagnosis and repair—not to mention the psych tests, which bleed away what little energy we have left at the end of the day—my mind's a blank. You'll get no great insight from me this day.

For what it's worth, here's one I thought of yesterday: I recently moved my family to a bigger house because

we felt squeezed in only 1700 square feet of space. But here at the hab, my personal space is smaller than the walk-in closet back home. And it's enough.

Anyway, we had a great day here. Concern about the weather got us up an hour early, which turned out to be meaningless when our computers reminded us it was daylight savings time again and the clocks had gone forward. But the forecast called for rain, so we suited up early to put the radio back up on the ridge. From the sad history of this project, you can probably guess what happened next: we had it working up there for all of about 15 seconds when suddenly it conked out again and refused to respond. Something had come loose. Again.

It turned out later that our own wiring was fine—it was the absurdly flimsy Radio Shack microphone cable that had failed, by shearing internally. But I was sick and tired of this thing finding new ways to break, so I hauled it back inside, spent an hour figuring out what had gone wrong and another half hour fixing it, and then rolled the whole wiring harness up in a sheet of printer paper and filled it with spray foam. By dinnertime I had a radio pop-sicle, sticking up out of a perfect cylinder of hard, yellow plastic. It was too late to try it out in the field, but I had a pretty good feeling about it just the same; it was still working on the bench—the expanding foam hadn't crushed or shorted it somehow—and the wires were a *lot* less likely to come loose from the ungentle handling of spacesuit gloves.

I would like to say here, in Bill's and my defense, that the gauge of these wires is fine even for manual work. That we're able to handle them outside, in sim, and nearly almost get them hooked up properly, is an achievement I'm proud of. Especially since Commander Alex, whose testing

proved that our gloves aren't as stiff as the real suit gloves on Space Station, insisted we duct-tape our fingers to increase hand fatigue. Really! This sort of ship-in-a-bottle task would probably never come up in a real space mission, so at least in this one small area, we're way ahead of the curve.

But I'm skipping the highlight of the day, which occurred in late morning when Alex and I finally got a chance to take off on the ATVs. We went north along the Lowell Highway, through four kilometers of the most breathtaking desert scenery I've ever laid eyes on. We took some pictures, but we know from experience that it's a futile effort. I mean, the pictures look good and everything, but they don't come anywhere close to capturing the full glory of this landscape. Space scientists can tout the virtues of their various robotic probes—which are indeed impressive—but in an environment as huge and richly complex as this one, there's simply no substitute for human thoughts and senses. I like to think these reports, meager as they are, convey some genuine sense of what it's like to be here, to see and feel all this, to live the dream of exploration. Could a robot do that?

The most jarring part of the day was seeing Julie out of sim. She came out to take pictures of us in our suits, for which we were all appropriately grateful, but she was wearing ordinary clothes, and she stepped right through the airlock like there was no such thing as decompression. Now, I wasn't delusional about this sim, and at no point did I actually think we were on Mars, in actual danger from its suffocating near-vacuum. But seriously, even a novel can be so engrossing you almost forget it's not real. It's that willing-suspension-of-disbelief thing, without which science fiction writers like myself would be out of business. So when you're dressed like an astronaut and living like an astro-

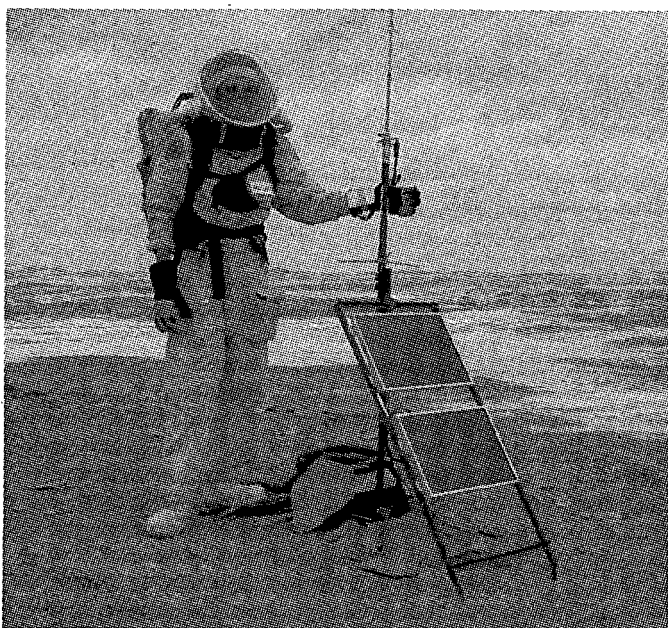
naut, and your space helmet is dripping with condensation because you forgot to defog it before you fastened it down, it's easy to buy into the realism. And it's weird—really—to see the stage crew walking around, working apart from the play itself. It just doesn't fit with the mental software you've been running.

But if that's the worst thing that happens in a day, then it must be a very good day indeed. The sun was out the whole time, and we never did get a drop of rain.

Day 10: Six Hours in a Space Suit

Ladders are a fixture of the modern home, but only when we need to get up to the attic or the roof. Most of the time, we stow them away out of sight. But here in the hab, the only link between the upper and lower floors is a kind of staircase-y, laddery thing like you'd see on a Navy ship. Going up it is straightforward—literally: you simply face front and start climbing on the balls of your feet, but on the way down, the stairs are just too narrow. To keep your balance, you need to use a kind of sideways step-step step-step, keeping a firm hand on the railing. If your hands are full, you put something down and make two trips, because it's a fall of ten feet and the rungs have sharp corners. One member of Crew 26 took that tumble, and a week later she was still downing ibuprofen for an aching wrist and tailbone. And she was lucky; she could easily have broken something.

But part of getting used to a place is getting used to its dangers. You never lose your respect for the ladder and the damage it can do, but after a while you lose your fear. You start going up and down in flip-flops, while toweling your hair, while thinking about EVAs and psych reports. You start using the space around the hole as a mini-office and laboratory. You stop noticing it at all, except in the vague, back-of-the-



Without noticing that his space suit sleeve and glove have detached and killed him, the author inspects a radio repeater at the dizzy edge of Skyline Rim.

mind way you notice the walls and floor. The skills for coping with it have migrated into the unconscious parts of your brain, and require no further attention.

In a very similar way, I found myself getting really, really comfortable climbing mountains in a space suit. Or one particular mountain, anyway, where I completed my sixth climb today to reinstall the remote radio, with Bill and Julie assisting. Practice makes perfect, right? Even (or perhaps especially) with tractionless space boots and a heavy toolbox and an imperfectly defogged helmet dripping condensation in the desert's morning chill. It also helps to be in a good mood; the radio had checked out on the bench, we knew the cable had no breaks in it, and we'd assembled a fairly sturdy structure to protect it all. We were full of hope.

Unfortunately, up on the hill it still didn't work. Or rather, it got decent

power and was able to transmit when the TALK switch in the hab was engaged. And the repeater, which last week we were convinced wasn't working, picked up and repeated every message. Hurrah! Unfortunately, the earphone at the remote radio control panel was not receiving good sound. When a transmission came in, Alex (who was playing HabCom at the time) could faintly hear the "roger beeps," but the voices were coming through as clicks and pops, not even remotely intelligible. An earphone is inherently a low-power device, and apparently the electrical resistance of a thousand feet of weather-beaten cable was enough to brown it out.

The good news was that with the radio and cable in known-to-work condition, this might just be a problem we could resolve from inside. Shortly before dinner I managed to get rid of an annoying 120-Hz hum in the transmit line, which at least proved that indoor

fiddling of this sort could be productive. Or keep me out of trouble, anyway.

But I digress. The main feature of the day's narrative is the marathon EVA I did with Bill Foltyn, to address Mission Support's request that we examine and photograph the R2 repeater on the distant cliffs of Skyline Rim. We could have visited the site out of sim, or we could have taken the "pressurized rover" (also known as a pickup truck) and suited up when we got there. But the truck was a real hoopty (for fun, you can look this word up on <http://wordwizard.com/slangstreet>), whereas the two surviving ATVs were in good condition, and anyway we figured it would be cool to make the whole trip in our suits.

And it was.

Part of the journey carried us out onto the shoulder of State Highway 24, where we must have made a strange sight for the six or so cars that passed us. But we had already surprised a couple of ATV riders near the hab, in that delightful (if accidental) way the Society for Creative Anachronism calls "freaking the mundanes." And I have to say, if riding an ATV is cool and riding one in a space suit is *really* cool, then riding in a space suit on a public highway is downright surreal. *Mad Max* meets *The Andromeda Strain*. It doesn't feel normal at all. I had to keep reminding myself that this wasn't a B movie.

But we got there, accomplished our mission, and got back. The view from the Rim is staggering: a 250-meter drop to the flat expanse of Mid Ridge Planitia, with the red Harris Hills—the area immediately around the hab—rising low in the distance, like gopher mounds. And beyond that is some lower, redder country, and to the west of Skyline Rim, after five kilometers of flat bedrock known as Factory Bench, rise the Blue Hills, and behind them the 460-meter sandstone towers of

Factory Butte and Caineville Mesa. The landscape is essentially a westward-rising staircase, fifty kilometers long and more than half a kilometer high. It's one thing to see it all on a map, and quite another to see it all, period.

But it was a long day. We put the space suits on at 9:30 AM, and didn't take them off again until 3:30 in the afternoon. Six hours of sweat, of pulling/pinching backpack straps, of duct-taped gloves that were literally designed to cause hand fatigue. By the end of the trip we were knotted up like the rubber motor-drive bands of a balsa wood airplane, and I had a serious case of "throttle thumb" and "radio ear," and was saddlesore besides. Remarkably, according to the map and GPS, including a couple of wrong turns and sightseeing (er, scientific exploration) detours, we covered a total of 70 kilometers. Could this be an MDRS record?

When we finally got home and desuited, the rest of the crew were all very concerned that we'd missed lunch and must be hungry. We were, sort of, but my personal hierarchy of complaints ran: shoulders, ears, hands, lower back, bladder, email, and *then* hunger. But Peter very nicely made sandwiches for us, and they did pretty much disappear in four bites.

Although this was "just" a simulation, I felt a real sense of accomplishment at this outing, because for real astronauts in the Shuttle and Station programs, six hours is the absolute maximum EVA time, and they don't have gravity or rough terrain to contend with! In fact, the longest EVA on record is 8 hours and 29 minutes, so for fake astronauts we weren't doing too badly out here. Even if our psych evals made us look like monkeys.

Also, Pete and Jim took a long, meandering ride in the morning, while Bill and Julie and I were up at the Rockpile with the remote radio, and

after we got back, Julie went out again with Alex for a ride to the extreme northern end of our contour map, to the water-rich site called Eden, where Crew 26's illegal terraforming experiment (the planting of radish seeds) occurred. Alex took pictures and samples from the area, which is notable for its several distinct colors of mud. So everyone got outside today, and for the first time in her fake-astronaut career, Julie Wardlow, our 19-year-old student from the south of England, went out twice. So it was a full, fun, productive day for all of us.

I'd like to say we celebrated and then went to bed early, but Mars exploration (real or simulated) is a job that begins shortly before 6 AM and ends shortly (or sometimes not so shortly) after 10 PM. With three hours off for meals and perhaps an hour of personal time distributed throughout the day, that's still twelve hours of continuous and often back-breaking (or cold, or smelly) labor. We wouldn't trade this experience for the world, but it does get tiring. Now if you'll excuse me, the main generator is browning out and requires attention. In the rain.

Day 11: Throwing in the Radio Towel

Sometimes it doesn't matter how hard you try. We ran out of crimp connectors today, and spent an hour fabricating new ones from plumber's tin and electrical tape. Then we doggedly made yet another EVA to the remote radio and confirmed that it doesn't work even when the earphone connector is unplugged. It sends and receives just fine, but will not play intelligible sounds through the speaker or earphone. But if you also unplug the microphone connector, it suddenly works again. And since the radio works just fine inside the hab with both connectors in, and since I've exhausted every other possibility, the

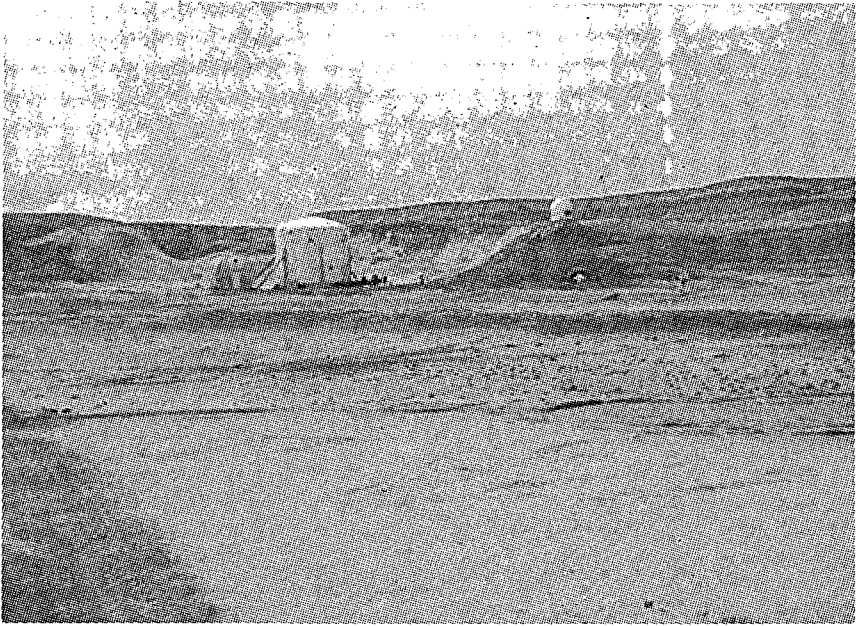
fault must lie in the outside cable itself. More specifically, either the blue or green wire is partially shorted to either the red or the white wire. Nothing else I'm aware of could explain these symptoms.

If it really really mattered and if I could rig up some sort of cable tracer, I could probably locate the fault somewhere up along that steep hillside, and maybe even repair it. But the cable is in terrible condition, and messing around with it would create as many problems as it solved. The insulation is, like, falling apart into PVC dandruff. What we really need is a new cable that's actually 1000' long, and actually intended for outdoor use.

But even in its half-dead state, the radio can receive *unintelligible* signals. That is, when a signal comes in, you do at least hear something, even if you can't tell what it is. And the radio does transmit intelligibly, with enough strength to be picked up by the R2 repeater, so it's conceivable that some sort of check-in code could be devised. "One burst of static means yes, five bursts means no, and ten bursts means we're in trouble and need assistance."

So the open question for Mission Support is whether we should make one more trek up that hill to set up this capability for Crew 28, or whether they will simply send Crew 28 out with a proper spool of cable, and have me write up some detailed instructions for connecting the radio. In either case I'll have done my duty as an engineer, to bring things as close to working order as possible, and recommend a course of action for a full fix. And I'm doing my duty as a journalist by writing about it here.

Sometimes you have to know when to cut your losses and stop throwing time and energy at a problem. But damn, it would have been nice to get that monster working. It would have made a better story.



Simulated astronauts at work and play around the Mars Society Desert Research Station.

On the plus side, Peter came up onto Radio Ridge with us today, and walked around looking at his feet. Geology, you see. At one point while HabCom was off fixing an ATV, I said to Peter, "EV 1, look, I've found a fossil!" To which his dry English reply was, "Have a look over here, then." Turned out he was standing on a mound composed almost entirely of fossil mollusk shells. Thousands upon thousands of shells, whose owners were caught here millions of years ago (188 million, according to Bill), and buried in some undersea mudslide that swept down on their nesting ground.

We might have salvaged a successful geological outing from the ruins of our maintenance mission—Bill keeps saying that on the flat rock shelf of Radio Ridge, meteorites should stand out like middle fingers. But instead we got chased inside by another dust storm, and spent the time catching up on psych evaluations instead.

There was a lot more to do out here, a lot more to see, but as we approached the middle of our second week I was increasingly, acutely missing my wife and kids. Maybe that ache subsides when you've been in space long enough, or maybe we'd all be better off if deep-space astronauts were people without happy families to pine for. But as Elton John reminds us, Mars ain't the kind of place to raise your kids. Not until they're older, anyway; mine would probably fall down the ladder. I can't be here, taking in this huge experience, and also be a good daddy. But when I get to feeling maudlin about it, I just think of our troops, marooned overseas for years at a time, with bullets buzzing overhead.

Radio troubles or no, I'm having a lot more fun than that.

Day 12: The Social Life of Utahnaughts

I've often thought communism is the right way to live on the smallest of scales—within families and inner-cir-

cle friendships. Really, it's just logical: share and share alike, and why own five extra "beater" vehicles when you can all share one or two? As long as everyone's cool, you really do get that "from each according to his ability" thing going. The problem, generally, is that any group larger than 10 people will contain at least one person who isn't cool. And that sucks, because suddenly everyone has to work ten or twenty percent harder just to stay in place. This is why communism fails on the large scale: because except in a few funky places like Sweden, people get really ticked off about freeloaders, and lose their incentive to work hard. Why contribute if it just gets Uncle Ernie drunk?

Fortunately, on Crew 27 everyone was cool. When we saw people working, we offered to help or we went and found something else useful to do. We didn't need a cooking or cleaning schedule, because the least-busy person always seemed to pick up the slack (and no, it wasn't always the same person). It was nice. There was also no hoarding here, at least that I was aware of. We'd all brought our little stashes of private goodies, but we hauled them out every few days like Christmas presents. Share and share alike. Wouldn't it be nice if everyone had a chance to live this way, if only for two weeks?

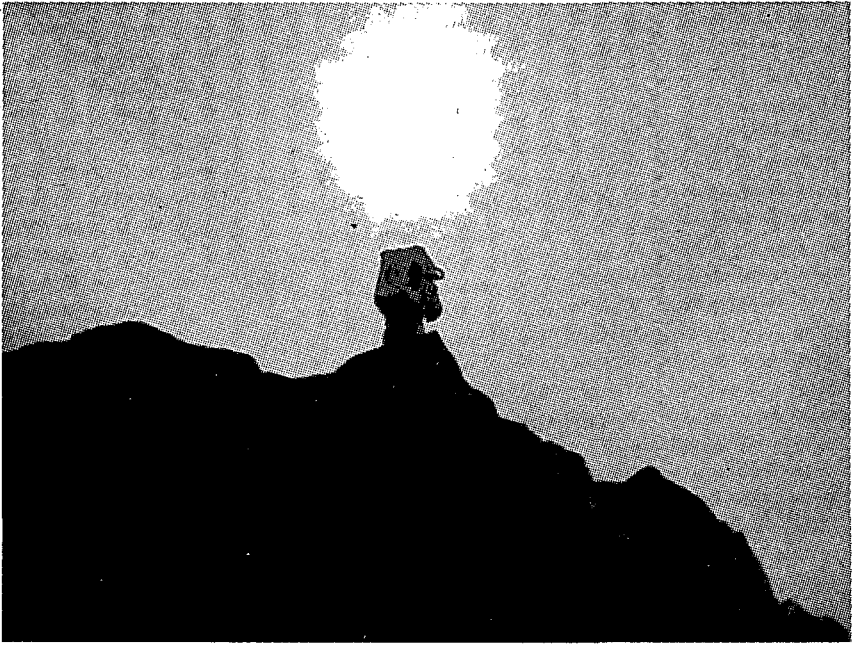
Multiculturalism was also a big plus. Crew 26 had assured me that having an international crew really enriched the experience, and after experiencing it myself I really did have to agree. Julie and Peter are from Britain, and although we speak (mostly) the same language and watch (mostly) the same TV and movies and hear (mostly) the same music, we were all constantly amused by little differences in culture and diet, mannerisms and speech. Peter gets a real kick out of American materialism ("You own three cars? One-point-five per adult? No wonder

you need a larger house, chum, it's to hold all your stuff!"), and I get a real kick out of his dry humor, and Julie's funny school slang. Alex was born in Peru, and while two decades in L. A. have Americanized him significantly, he still brings a unique point of view to the table. He's worked first-hand with astronauts, but he's also lived in a country wracked by terrorism, and been a foreigner in his own adopted nation.

We'd been out there for long enough to develop an embryonic culture of our own, and it was neither British nor American nor Peruvian, but some tough, tech-savvy, funny-talking hybrid of the three. And that's a really good thing; exposure to the socialist lifestyle and British/Peruvian frugality had given me a new perspective on my own, comparatively lavish way of life. I could already picture myself walking into my own home like a poor country stranger. Do they really need all that space, all these things, all the kilowatt-hours and kiloliters of water they consume in a week?

Refilling the diesel generator three times a day is a good reminder that energy is not free, not magic, not disconnected from the physical world. It's more than just numbers on a monthly statement; when we run the toaster oven, we can *hear* the generator revving up, and we know its tank will run dry just that much faster, and come rain or wind or gloom of night, we'll have to go out there (through the imaginary "pressurized tunnel") and refill it. Here on "Mars," even flipping on a light switch is a consequential act.

The water situation is even more educational. Martian hygiene standards are very different from American norms; we don't flush the toilet for "number one," and we don't flush paper, and we don't take daily showers. We can't; we simply haven't got the water for it. It's also cold most of the



Mars Society "Astronaut" Bill Foltyn atop Phobos Peak, in Utah's North Pinto Hills.

time, and you have to run about two gallons of cold water before the warm starts to flow, and anyway the water heater only holds five gallons, which we have to share between us and at least a gallon of which has to go for dishes every night. This kind of thing discourages regular bathing, so most days we end up using a moistened washcloth, and taking "navy showers" once or twice a week. That's where you spend a minute getting wet, then turn the water off and soap up, then spend another minute or two rinsing off. This takes about three gallons altogether, so you end up stepping out of the shower just as it's finally getting hot.

At home I've been known to stand under the full shower blast for twenty minutes, using up forty gallons of water and 40,000 BTUs of heating energy, equivalent to about a third of a gallon of generator fuel. If I ever do that again—and realistically I'm sure I will,

sooner rather than later—I'll at least have a firm grasp of the resources I'm squandering. But I'd learned something else as well: we humans have a natural scent, a natural coating of oils and bacteria adapted specifically for the purpose of protecting our skin. After four or five days it stops being gross and starts feeling sort of, well, natural. It's not at all like the stench of a gym bag; I suppose the good bacteria eventually crowd out the stinky ones, and the only real problem is the buildup of crystallized (or crustalized) sweat. And socks. Unlaundered socks really do get to stinking after a few days. But it does make me wonder why "civilized" people spend so much time and effort to scrape off this protective film, only to replace it with scented lotions and pomades, which don't do nearly as good a job. Are we nuts? Probably.

But I should tell you what happened today, because it was another good

ANALOG

one, in a laid-back sort of way. Our morning was rained in again, but this time, instead of cabin fever, it gave us a chance to linger over breakfast, to catch up on paperwork, to read our email while good music and bad movies played in the background. Truthfully, it was a relief not to be rushing outside again. Outside is nice, but it's also a hassle, and today was definitely *not* a day for long journeys or multiple cycles through the airlock. We were all too tired for that. It was also nice to chitchat and eat snack foods, to take a few hours to consolidate our group culture. There's a lot we don't know about each other outside the context of the hab, and what somebody's like here is only one facet of what they're like generally, so it's nice to meet the full person every now and again.

But we'd been wanting to hike up Phobos Peak—visible all day through the hab's largest window—and when the weather partially cleared after lunch, we decided to make it happen. But we were also full of gung-ho team spirit, so in a breach of protocol we decided we should all go out together, leaving no HabCom behind. We didn't have six working space helmets, though, so Peter opted to make the journey out of sim, with a scientific eye toward measuring speed and difficulty differences between suited and unsuited people. (It turned out the suited people were slower.)

We also breached protocol in a more serious way, by neglecting to bring along the EVA first aid kit. We became acutely aware of this when Bill "Mountain Goat" Foltyn climbed atop the peak's highest boulder, which is the size and shape of a house and definitely not something you'd want to climb up in a space suit. Fortunately, though, he found his way back down again without incident. We were actually a bit more worried about Julie, for whom mountains are

an alien concept, but though she was trailing and tired and dropped into her bunk the moment we got back inside, she completed the same hike as the rest of us. Bravo for the British.

Meanwhile, as Julie and Alex and I were cycling through the airlocks, Bill and Jim headed out on the ATVs and, almost by accident, found a meteorite up on Radio Ridge. Meteorites can be found anywhere on Earth, but on a flat bench of pale-colored rock, they really stand out, so meteor hunting up there had been one of our mission's science goals all along. After the remote radio problems, it does feel good to chalk up a win.

Day 13: Pining for Here

"Homesick" is a funny word, but an appropriate one. No matter how hard you wish to be in two places, you're stuck in the one and dreaming of the other. The best you can do is swap them. At handover, five of the six members of Crew 26 had told me they weren't ready to go home yet—they'd only just found their feet, and what they really wanted was another week out here to use the skills they'd so painstakingly acquired. I know exactly what they mean, although we got a much better handoff than they did, so we lost fewer days to cleaning, organizing, and learning curves. By now we'd also stayed in sim for nine continuous days, where they did a kind of four-on-one-off thing, so I would say we were more fully immersed in the environment, and in the sim itself. That's a big help in getting the most out of the experience. When we left, I hoped we wouldn't feel quite the same ache of unfinished business.

But one Crew 26er told me he was done, and very ready to go home. Notably, he was the only one with kids. MDRS explorers seem, disproportionately, to have fiancées or long-term significant others, or to be newlyweds. It's a kind of Neverland, easily accessi-

ble to students and free spirits and Youth Mission spaceophiles, but very remote for mommies and daddies, who have more complicated lives from which to extricate ourselves, and a lot more strings attached to our hearts.

The troops, of course, have it worse. I hadn't lost sight of that, and I really would keep these whiney feelings to myself, except that I'm the mission journalist, charged with the solemn task of telling it like it is. And it is a bit lonely on Mars, even though we have each other.

Like a real illness, homesickness waxes and wanes and sometimes strikes without warning, and the people afflicted with it really do retreat to their beds, or to the solace of familiar activities. In our crew, Peter appeared to be the worst case, which is ironic on the surface of it, because he's not married and has no children. But he does have a long-term girlfriend, and out of all of us he's certainly the farthest from his normal orbit. Bill and I are self-employed, and the Boeing corporation is paying Alex to be here, and Julie and Jim are both students. But Pete has a real, regular-guy kind of job with the local government in Norwich, England. It must seem a long, long way from Utah.

I'm probably the second most affected, which is normal and expected, because I'm the only one on this crew with kids. Kids grow and change so fast, and I know from painful experience that two weeks is plenty long enough for them to look different, to sound different when I finally get back. I'll have missed another irreplaceable chunk of their too-brief childhoods. Still, it's weird and frightening how quickly we adapt. If this situation were permanent—if we were stranded, if somehow our old lives didn't apply anymore—this "new normal" would fit like a spacesuit glove, probably forever. Human beings can

get used to anything, no matter how badly it makes the hands ache. And that's a bit scary.

Also scary was the time, shortly after sunset, when I climbed up on the hab's domed roof to perform a signal-strength experiment at the behest of Mission Support. It's a long way up, see, and it's smooth and not at all flat. Mars terrain offers a lot of variety.

Another case in point: we were visited this morning by, of all things, a journalist. He was from the Utah wire service, and wasn't really sure what kind of story he was going to write or who was going to publish it, so we showed him around a bit, answered some questions, then got on with our important business of loading Peter and myself on the ATVs for an expedition to the extremes of our topographic map, in search of a route through the Hubble Highway to Coal Mine Wash, and thence, somehow, up onto Skyline Rim. We didn't find our Northwest Passage—I doubt those towering cliffs will admit an ATV at any point, no matter how hard we search—but we had a great time trying.

If Julie had never hiked before coming to Mars and needed to learn how in a space suit, Peter—perhaps more seriously—had never driven a motorized vehicle. And we handled some pretty rough terrain today, including one deep, dry wash that nearly cap-sized us both. Heh. And he loved it. What better way to learn how to drive? I'm glad he got the chance today, because the late afternoon opened up another storm on us, and who knew what tomorrow—our last day of simulation—would bring?

All of a sudden time is very short here, and even if the weather holds we're clearly not going to accomplish all of our goals, like getting the observatory running again and installing a functional remote radio cable, and nursing the Green Hab all the way back to health. That part of it is hard,

because you really do develop a sense of ownership at a place like this, and it becomes very important to communicate your plans to the next crew, because if you don't the knowledge will be lost, and future crews will wander around in the same haze of rootless disrepair that Crew 26 inherited when they arrived. Sometimes the knowledge is recovered or reinvented, but there's a lot of unidentifiable junk lying around which nobody knows anything about. And I'm sure someone, at some point, had plans for it.

Life is like that, I'm afraid. It's easy to lose track, to run out of time. Better ride while you can.

Day 14: Missions End

I would have expected our last day to be a bit maudlin, but in fact it was the most relaxing day we'd had, and truthfully the most fun. Bill, Jim, Pete, and I enjoyed a leisurely morning of chitchat around the breakfast table, and with Alex and Julie out on an ATV ride that was both early and long, we felt free to let the humor turn a bit toward the bawdy side. I didn't realize I'd been holding that in, but although Julie is a "one of the guys" kind of gal, she's also 19 years old, and marooned in the wilderness with five older men. And if communal living had taught us anything, it was to worry more about each other's feelings than about our own. Always err on the side of diplomacy.

Anyway, our latest round of radio testing (which included prying loose a connector with a screwdriver blade) had damaged the remote radio again, so I spent an hour re-repairing it, and then Bill and I made a final EVA up the hill to put it in place, and test it in the send-voice-receive-static configuration we'll be handing off to Crew 28. (Hey, it was better than nothing, which is what we inherited.) That done, we saddled up the ATVs, which Alex and Julie had returned by then, and rode

up onto Radio Ridge, and followed the Blue Hills all the way to the base of Skyline Rim. By the direct route it's a surprisingly short journey, but the cliffs tower impressively over the flat bench of Mid-Ridge Planitia, and the ground beneath them is littered with house-sized boulders that have fractured off over the millennia. You get a definite (if irrational) sense of not wanting to stand too close.

And as we climbed back into the airlock for decompression, the circle of our mission was closed; nine days ago Bill and I had done the first EVA for Crew 27, and today, as it turned out, we were finishing up the last. When we got inside and put our suits away, Commander Alex declared our research, repair, and exploration duties complete. From there on out it was all paperwork and handover operations. This involved cleaning, organization, the emptying of trashcans and deodorizing of space suits. . . .

And then even that was done, and we were finalizing the written procedures we'd created, and typing up our final mission reports, findings, trouble tickets, and recommendations. There were a lot of these—we'd been a conscientious crew, intent on leaving things better than we found them. And when *that* was done, there was nothing left to do but walk out into the open air—feeling the alien sensation of wind on our faces outside the "pressurized tunnel" for the first time in almost two weeks. We were standing right out there in front of the airlock! Without helmets! Seeing the actual landscape with our own two eyes! So we set the timer on a tripod-mounted camera and posed for some group pictures. Then we sent Jim and Pete and Julie into Hanksville for some beer. We had a lot to celebrate.

After ten long days, we were finally out of sim, back in the Utah everyone else knows, with oxygen and convenience stores and whatnot. But in a



Crew 27 bids farewell outside the front airlock.

way this was one of the most vivid and realistic moments of the entire simulation, because real space missions end, too. Shuttles de-orbit, space station crews rotate out, and return vehicles blast off from some desolate surface and head at last toward the warm lights of home. It's a happy moment, mostly.

Was it exactly like Mars? No. We experienced a few days of heavy rain and mud, and a few more of anomalous heat, neither of which we'd encounter on Mars. We also enjoyed a minor infestation of desert mice, and a diet with improbable amounts of fresh produce and bottled juice. There was also the pressurized tunnel itself, which gave us all the chance to breathe fresh air, or diesel-smoggy air during the actual act of refueling the generator. And there's another unrealism, because on Mars we'd have either a large solar array or a small nuclear reactor, and neither one would need to be serviced three times a day.

And yet . . .

We did grapple with space suits and airlocks, radio problems and hard-driving astronaut schedules. We'd explored an alien wilderness and reported back meaningful discoveries (like the stone "blueberry fields" Bill found which closely resemble the ones recently photographed by the Opportunity rover on Mars). We'd been studied by psychologists and human factors researchers. We'd been driven inside by dust storms and dry lightning, and we'd successfully developed procedures for splicing teeny, tiny wires in a big, stiff space suit glove.

Even a video game can yield a sense of accomplishment, of new problems faced and defeated, new vistas explored. And this experience had been far, far more immersive than any game. Because it wasn't fake: we really were there on a Mission to Utah, and we'd done our jobs well. When a real Mars mission does finally take place, I'd like to think that most or all of the astro-

nauts chosen for it will be, in one way or another, graduates of these Mars Society programs. And if one or more members of MDRS Crew 27 should be included, why, so much the better.

Day 15: Blastoff

This was handoff day, set aside for briefing and training the incoming crew. The new commander, Gus Frederick, was an MDRS veteran, and as the Mars Society's webmaster, he'd been reading all the crew reports for heaven knows how long. He wouldn't be coming in cold like we did. Still, he *would* be coming in with preconceptions. We'd made a lot of improvements, documented a lot of known problems, and written new flow diagrams and procedures, and we wanted to be sure those were handed off smoothly.

I got up at 7 AM to refuel the generator (Bill, God love him, had filled it at 11 PM to give me an extra hour of sleep), and then got about the business of putting the last of my tools away, printing out the last of the procedures I'd written, and finally bringing the car around and packing my things. I deliberately left my laptop for last, because Mission Support still wanted one more XO/journalist report out of me. This seemed strange given that I was leaving in the early afternoon, shortly after the new crew arrived, and especially given that my dry, unjournalistic "Final Summary Report" had already been submitted, chock full of engineering details and recommendations. But this was the Mars Society's mission, not mine; they were calling the shots. I also owed the project one more cognitive state evaluation and social psych questionnaire, and since human factors research was a big part of why we were there, I did want to hold my end up.

I don't mean this in any kind of nasty or critical way, but by the end of our rotation I was less awed by Crew

26's performance than I had been on first glimpsing it. They were laid back because they had no energy to waste. They were efficient because this place demands efficiency; the only alternative is darkness and cold, foul water and uncooked food, lost astronauts and inoperative equipment. And they had a bit of that, more so than we did. This was mostly not their fault, but I'm not made of stone, and I can't help feeling a bit of pride for the fact that we never overflowed the water tank into our staterooms, or tripped even a single circuit breaker. Of course, Crew 26 taught us how to avoid these problems, and no one taught them, so they get a big share of the credit for our success. But even so, we'd done a decent job with the knowledge they passed along.

Finally I had a Navy shower, so I could come home without stinking, and we sat around watching *Sphere* on a laptop screen and burning all our pictures onto communal CDs. The new crew was an hour late—which wasn't bad considering there was a blizzard tearing through the Rockies. But when they finally arrived, it was fascinating to see them climb out of their cars and look around. Their job assignments had already been worked out, and they took in our tour like professionals, bright-eyed and a little bit nervous here at the start of their own two-week adventure.

Sadly, I needed to leave 18 hours earlier than the rest of my crew, and the blizzard promised to make my drive back to Denver a long one, so I hurriedly typed up this final report—the one you're reading right now—while hastily wolfing down some lunch Jim had made for me. Crew 27 had been pretty good about sharing important knowledge between multiple people, so there wasn't really anything I *had* to explain to Crew 28 that Bill or Alex or Jim couldn't cover just as easily. But just to feel good about

myself, I gave a 20-minute briefing on the remote radio and the R2 Repeater, and my recommended mission safety precautions given their marginal functioning.

And then it was time to fold up the computer and hug my crewmates goodbye. It didn't feel final, though; we'd become too close not to keep in touch. I knew I'd be having dinner in Boulder with Bill and Jim in a week or so, and I would visit Alex in another month when I was in L.A. on business. As for Julie and Pete, there's always email. There are always frequent flyer miles. We live on the *same planet*, for crying out loud.

But it was a touching moment when they all stood outside the hab, waving goodbye to me as I pulled away. It didn't feel strange to be in a car instead of straddling an ATV, and it didn't feel strange to be outside without a space suit on. I'd done these things before. But it did feel weird and wrong to be driving away from my crew, my friends, without radio contact. In fact, I had to stop and roll down the window so we could keep talking, albeit louder and louder as I pulled away.

And on my way out, I passed Crew 28, standing forlornly around the generator they'd just inherited, which had greeted their arrival by blowing out a fuel line the very first time they tried to refill it, spilling diesel all over the place.

"Welcome to Mars!" I called out to them without a trace of irony, because even if they didn't know it yet, they were already having the time of their lives. And like me, they'd have mixed

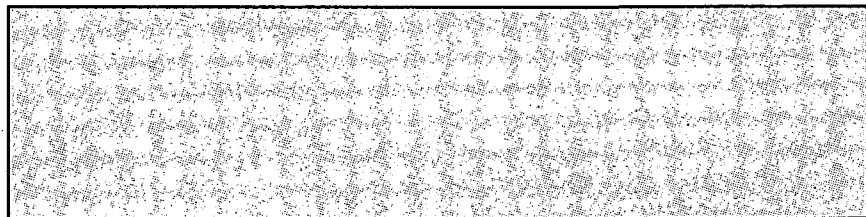
feelings when it was finally time to return once more to Earth.

Epilogue: The Big Dry

My house does seem improbably huge and splendid—I'm afraid to walk around for fear of messing it up! And on that first night in my too-soft bed, the absence of the generator's soothing hum woke me up several times in confusion and distress. But the strangest thing about coming home was taking a shower. I couldn't bring myself to take a "real" one in the old style: two minutes of waste to clear the cold water out of the pipes, and then twenty of steaming tropical heat and power massage. The most I felt comfortable with was a sort of extended Navy shower, a lukewarm trickle well under ten minutes in length. And even that seemed to strip all the "natural" off my skin, leaving it not so much clean as *scourged*. I felt unpleasantly dry and itchy for hours afterward.

"Why do we do this to ourselves?" I asked my wife.

"So we don't reek," she told me, wrinkling a nose at my laundry bag. It smelled awful, like something from another planet. And then at last I felt myself disconnect from "Mars." I really was home. But in the days since then, I've been slow about getting back into old habits, old ruts. Maybe I've learned a thing or two, or maybe I'm just recompressing to the Earth-normal worries of money and time, TV and fast food. Ours isn't a bad planet by any means, but it does take some getting used to. ■



In the Loop

Brian Plante

Maybe the difference between “real” and “artificial” is artificial. Maybe there are just different kinds of real—but the *difference* is real.

I was 22 years old and fresh out of college when I took a job as a disrupter at the Shady Rest VR Home, which operated out of an office on Park Avenue. My bachelor's in psychology from NYU was good for nothing without a graduate degree when it came to finding a job, but I had had enough of school for a while, so the Shady Rest was the best I could find. It was supposed to be an easy job and you didn't need to know anything special or do anything difficult. You just had to walk around and talk to the spooks.

My first day on the job, they barely gave me any training. “Just go. Interact with the residents. Make friends. Mingle,” was the orientation I was given. I was strapped to a reclining chair in a small cubicle, wired up by a technician, and fifteen minutes after reporting for duty, I was in the Shady Rest with all the dead people.

They called it a “Virtual Retirement Community,” but the folks in it weren't just retired from their jobs—they were retired from life. People that could afford not to die had their brains scanned and modeled into computer programs while they were on their last legs, and when their bodies gave out, *poof*, they were resurrected as software spooks at the Shady Rest.

As a disrupter, it was my job to just be myself and socialize with the spooks—keep an eye on them and keep things moving. It sounded like easy work, and the pay was just so-so, but I figured it wasn't something I'd make a career at. I just needed something to pay the bills so I didn't have to go back and live with my parents. Not that they were bad parents or anything, but at the age of 22 I felt it was time to be out on my own.

The first thing I noticed about the Shady Rest was how perfect every-

thing was: the sky a uniform blue with occasional puffy white clouds, the temperature comfortably warm, the trees vividly green and waving in the gentle breeze, the streets all spotlessly clean, and every lawn well manicured, with fragrant flowers lining every border and birdsong filling the air. That last detail was odd, as I didn't see any birds flying about or perched in the trees.

I had appeared in the middle of a narrow street, but there were no cars in sight—not even the sound of automobiles in the distance. It was quite peaceful. Good-looking dead people went about their business.

None of the spooks seemed to notice that I had appeared in their midst. Without any real instructions to go on, I wasn't sure if I should approach them or let them come to me, so I just started walking around at random, checking the place out. I felt a bit like a kid on his first visit to Disney World, just looking at everything and taking it all in. There was a park, a movie theater, restaurants, shops, offices, an art gallery, grocery store, country club, and golf course—all the things you would expect in a comfortable little town, and then some. Everything except cars.

The place wasn't very big at all. After an hour of walking, I had circled the entire village. The Shady Rest, I'd been told, was fairly modest as these things go. By the size of it, I'd say there were probably no more than a couple of thousand spooks. During my walk, none of them had spoken to me, and everyone seemed preoccupied, so I wasn't really sure what I was supposed to be doing.

I walked back to the country club and sat on a bench by the two clay tennis courts, and watched a pair of athletic young men play. For the first time, it occurred to me how odd that really was. This place was a retirement home, so I had it in my head that

everyone here would be elderly. Stupid me. Everybody knows you can appear however you like in a VR world like this. Why would a spook spend eternity as an old, wrinkled geezer when he can be young, fit, and handsome? It was only software, after all. Thinking back, it wasn't just these two guys playing tennis that were young, but nearly everyone I had seen. I didn't recall seeing a single old person at all in the village, and only a few you might call middle-aged.

The tennis players were good. Really good. I'm pretty capable with a racket, but I watched those two guys bash the ball back and forth at a hundred miles an hour, for some surprisingly long rallies until one or the other barely missed a line by inches or hit a clean winner. Either of them could have wiped the court with me. They looked like tournament professionals, way out of place for a friendly game in a little club like this. After watching a handful of long points, I figured the two were very evenly matched and likely to be battling it out for a lengthy set, and decided to move on.

At the swimming pool, all the men were tanned and fit, and swam like sharks. The women all had gorgeous figures struggling to burst out of seductive bathing suits. One magnificent beauty did a perfect two and a half somersaults off a one-meter springboard, hitting the water with an absolutely vertical entry that made no splash whatsoever. Was that even possible off the low board?

Farther on, golfers whacked 300-yard drives and holed 50-foot putts. One young lady tended fragrant roses the size of softballs in her immaculate front yard. In an ornate gazebo in the park, another woman was singing Broadway show tunes *a cappella*, in a voice that rang like crystal.

Everywhere I looked, people were performing amazing stunts and feats of skill that would have stopped traffic in

the real world. But there was no traffic here, and no one seemed to notice how unusual it all was, except me. Was I supposed to say something to them, or should I take it all in stride? Was a 150-mph tennis serve or a 350-yard drive off the tee something to be remarked about here, or would that mark me as a "tourist" for noticing?

The spooks never approached me, never tried to speak to me, but I knew they were aware of me. Every once in a while, I'd catch one of them furtively glancing at me between their impossible feats, then quickly looking away to avoid eye contact. Were they all showing off specifically for me? More likely, they knew I was a new employee and were letting me know who they were with their skills. Was there something special about me that was causing all those surreptitious glances?

I looked in a shop window and saw my reflection in the glass, and realized why nobody was making any effort to make me feel like I belonged here. In contrast to all these perfect people, I was just ordinary me. Dave Beamon from Queens. I looked in VR like I looked in life: a bit short and plain, with coarse brown hair that refused to stay where I combed it and a nose with a few extra angles that nature hadn't provided. I was wearing moc-casins, chinos and a checked short-sleeved shirt, same as I had on when I reported to work. A regular guy in a world full of remarkables.

"Watcha looking at?" a female voice said from a bus stop bench farther down the sidewalk. That really stood out—a bus stop bench. Why was there a bus stop bench if there were no buses or cars? I probably wouldn't have noticed the lady sitting there at all if she hadn't just spoken to me.

"Um, just seeing what I look like," I said.

The woman made a face.

"My first day on the job," I added. "I didn't know if I looked the same until

just now. Too bad for me, but I do."

"You look okay," she said, standing up and facing me.

The first thing I thought was that her hair was probably too short, since her features weren't really feminine enough to carry off such a boyish style. Then it hit me, what was really wrong with her look was that she wasn't a raving beauty like all the other women I had seen so far. She wasn't bad looking, she was just *plain*.

"You must work here too, huh?" I said.

"Clever boy," she said. "You figured that out just by looking? I suppose my peaches-and-cream complexion gave it away."

Actually, she had quite a few freckles around her nose, so I guessed she was joking.

"You look all right," I said. "But it's obvious you're not one of the spooks."

She made a face at me again. "Listen, New Guy, you got a name?"

"It's Dave."

"Okay, Dave, I'm Gwen Marzetti. You've got a lot to learn if you're going to keep working here. Jeez, those morons running this place just pick anybody off the street and send them in without any training. The people who live here are *residents*, not spooks. Got that?"

I nodded. "You *do* work here, then?"

"You're damn straight I work here. Have you had anything to eat yet?"

"Eat?" I said. "Do we need to eat in virtual reality?"

"Well, you won't starve," Gwen said, "but it looks stupid if we just stand here on the sidewalk arguing. There's a good place across the street. Do you like Italian?"

"Italian's good."

"Then let's go."

Gwen stormed across the street and I had to walk briskly to keep up. The restaurant was small, with only a half dozen little tables, but everything was

impeccable. A stiff waiter seated us and handed us menus.

"Try the veal saltimbocca," Gwen said. "It's delicious."

"I'll have the chicken parmesan," I said. "And a cola."

Gwen looked annoyed that I didn't follow her recommendation, but the waiter took our orders without comment. I was surprised how low-key he seemed in this world where everyone was over the top.

"What's his story?" I said, pointing at the departing waiter. "He seems a bit of a . . . an underachiever compared to the other spooks—um, *residents*—I've seen so far."

"He's not a resident, he's a sim. Somebody's got to be the servers and cleaners and ticket-takers around here. All the residents are rich folks who get to be whatever they want, and look the way they want. The sims are just computer modules created in a lab, not modeled on real people, to do the dirty work."

"Oh," I said. "That's almost kind of sad."

"Don't waste any sympathy on the sims," Gwen said. "You're here to keep the residents happy."

"Well, so far the residents are mostly ignoring me."

"On the contrary," Gwen said, "as a real person, especially a new one, you're the center of attention, wherever you go. The residents may not outwardly acknowledge that you're there, but they definitely notice. Most of the time, you have to make the first move if you want them to talk to you. The residents get stuck in loops, doing the same things over and over, and pretend not to notice you unless you go out of your way to be a part of their lives."

The sim waiter brought out my cola and a bottle of Bardolino with two wine glasses.

"Compliments of the chef," the waiter said.

"Are we allowed to drink alcohol while we're working?" I asked.

"I think the chef would be disappointed if we didn't," Gwen said, pointing to the kitchen door. In the diamond-shaped window, an older Italian-looking man was watching us.

"*Salute!*" Gwen said and lifted her glass in his direction.

"*Salute,*" I said, joining the toast.

Through the window, I could make out the Italian man's mustachioed smile.

"Congratulations," Gwen said. "You've just earned your pay for the day."

"That chef doesn't look like all the other residents," I said. "He's the oldest-looking person I've seen, and he's definitely overweight."

"When Carlo goes to the club, he'll be young and tanned and slim," Gwen said. "Right now, he's acting the part of the great restaurateur. This is what he enjoys, so just play along."

I'm not much of a wine-drinker, but the Bardolino tasted wonderful. When our food arrived, it was the best I'd ever eaten. Who would believe that chicken parmesan could ever have tasted so good? Even the bread was ambrosia. Going back to the real world was going to be a letdown after all this perfection.

"The food's great, right?" Gwen said.

"I've never had Italian food like this," I said.

"Okay, here's where you can really go the extra mile. Have the waiter call the chef out, and then heap some praise on him. That's the sort of thing you're expected to do here."

I wasn't much in the habit of flattering chefs, so I said, "Why don't you do it?"

"Carlo knows me," Gwen said. "I eat here all the time. The whole point of being a loop disrupter is to introduce new elements into the residents' lives. Otherwise they just get themselves

stuck doing the same things over and over."

I called over the sim and asked to see Carlo. The portly chef came to the table and beamed with pride when I told him, in all honesty, that the chicken was the best I'd ever eaten.

"You're a nice young man," Carlo said. "You come back again soon and I'll take good care of you."

"You can count on that," I said.

The waiter brought us the bill, which surprised me. I didn't know you needed money in the Shady Rest, or if I even had any, and I let the check lay there while I searched my pockets.

"Yes, you have money if you need it," Gwen said. "Just think of your wallet being where you usually keep it, and it will be there, with enough money for whatever you need."

I reached around to my back right pocket, and sure enough, it was there. "I could get to like this place," I said. "How much should I tip the waiter?"

"It doesn't matter," Gwen said. "Money doesn't mean much here; it's only a prop to make things seem more like the real world. Besides, the waiter is just a sim."

I paid the bill and we left the restaurant. It had gotten dark outside while we were dining. Gwen walked down the sidewalk with me, and we came upon two teens kissing and groping each other under a lamppost.

"Get a room, you two," Gwen said.

I must have looked a bit surprised, because Gwen said, "They can't really do it, you know. Sex, I mean. Not completely. The software won't allow any orgasms here at the Shady Rest. They used to let the residents have their orgasms, but too many of them just spent all day at it, and nobody wants to visit and see their dead relatives having that much fun, I guess."

After we were out of earshot, I said, "Well, I think that's kind of refreshing, to see kids like that in a place like this."

"Larry and Diana are old enough to be you grandparents," Gwen said. "They just like making out in public places. It's not so much the kissing they like, but the thrill of getting discovered once in a while."

"Then my work here is done," I said, smiling.

"Now you've got it."

After a few minutes, my watch started beeping, which was odd, since it was an old analog watch without an alarm.

"Your shift is up," Gwen said. "They're calling you."

"Will I see you again?" I asked.

"If I don't quit first," she said. "It's a small place. We'll bump into each other."

And that was my first day at work. The images of the Shady Rest faded, being replaced by the drab interior of the duty-cubicle. The technician plucked the wires off the harness at the back of my neck and I thought how ordinary everything looked in the real world.

Back home at my studio apartment in Queens, I ate a package of ramen noodles and drank a beer, and wondered what to do that night. I felt like celebrating, since it was my first day as a working stiff.

From a drawer, I retrieved a scrap of paper with a phone number on it. Barbara Maxwell, from NYU. She had been in a couple of classes with me, and I thought she was cute and maybe just a little interested. She lived in Brooklyn, so I called her up and asked if she wanted to go out for a drink. Not tonight, she said. Or the next night. Or the weekend.

I counted my money and decided I could drink another couple of beers at home, then have enough for a couple more at the bar around the corner, called, appropriately enough, the Corner Bar. Too bad I couldn't just pull out as much money as I needed like at

the Shady Rest.

At the bar, I scarfed down their peanuts and drank their beers, chatted with a few semi-friends, and said hello to some pretty young things, but when it was time to go home, I was alone.

Welcome to the working world, Dave Beamon.

The next day at work, I stopped by the gazebo to hear the pretty lady sing. Two sims were pretending to listen to her, but she sang well enough to deserve a real audience. Her voice wasn't exactly operatic, but warm and familiar, and she sang famous Broadway tunes. She was good enough to carry the songs *a cappella*, but I wondered if she actually had that talent in real life or whether a beautiful singing voice was just some attribute she had assumed in her virtual reincarnation.

No matter whether the voice was authentic or not, I clapped along with the sims, and meant it, when she was finished singing "Send In the Clowns." She ignored the sims and smiled my way. I smiled back.

At the country club, I watched the same two tennis players battling it out again, knocking the fuzz off the ball. I whistled and clapped when one of them hit a tremendous overhead to end the point.

"Great shot," I said.

"You call that a shot?" the other player said. "My grandmother could have hit that one."

"You hit some good ones, too," I said to him.

The next couple of points went back and forth like lightning. I could barely follow the flight of the ball, and my neck was getting sore (and who knew *that* could happen in VR?) from whipping my head back and forth. Both of the guys kept sneaking glances at me to make sure I was still watching. Finally, between points, I said, "Both you guys are too good for

me. I'm working up a sweat just watching."

At the pool, the lady on the diving board did three and a half somersaults. I waited until she came back up to the surface before directing some applause her way. She smiled and waved back at me.

Back in town, I checked out some of the many small shops. The grocer was a sim, as were the barber and the clerk at the hardware store. The sims all looked different, but you could always tell they were sims. There was just a stiffness about them.

The owner of the antique shop was a spook. In his role as the salesman, he had chosen to appear as an older guy, thin, with hawkish eyes that followed me around the store as I looked over his sundry merchandise. I picked up a mechanical toy bank that had the figures of a hunter and a lion. You were supposed to put a penny on the hunter's gun and the mechanism would shoot the coin at the lion. I reached in my pocket and found a penny, and gave it a try.

"Careful with that," the shopkeeper said. "It's very old."

The paint looked too new, and the mechanism worked perfectly, which led me to believe the item was not truly authentic. When this toy was supposedly manufactured, pennies were still made of metal, not the plastic ones we use today, and I doubted that it would operate exactly the same, VR or no VR, but I didn't say that to the shopkeeper.

"What would something like this cost?" I asked.

"A classic like that, from 1911, in good condition," he said, sizing me up with his eyes, "I could let you have for \$6000."

I didn't flinch. Everything in the shop was a software fabrication. The guy could just have easily stocked his shop with "authentic" antiques as reproductions, so I had to figure that

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cheating people was part of his fantasy life. He enjoyed outsmarting his customers.

I pulled the wallet out of my back pocket. Sure enough, there was \$6000 in it.

"I don't know," I said. "That's pretty steep, even for such a nice piece. Would you take \$4000 for it, in cash?"

"Four thousand!" he cried like he'd been shot. "Look, look, this is in perfect shape."

I threatened to walk. He said maybe we could deal. After some back-and-forth, he let me have it for \$5100, and he really worked me hard for that last hundred. I made a big show about how, "The kids will love this," and, "What a steal at this price," and he just smiled slyly at me while he wrapped it up.

Back on the street, I ran into Gwen outside of Carlo's. I asked if she wanted to go in, but she said Carlo would just get in another loop if we went back too soon, and she took me to a Chinese place instead. The waiters and chef were all sims, but the food was still better than anything in the real world.

"This place is good, too," I said.

"They're all good," Gwen answered. "So, how's your second day on the job going? Are you getting used to all this yet?"

"Sometimes I wonder if I'm not more comfortable here than in the real world," I said. "Frankly, I'm still amazed that they need people like us at all."

"The residents are software," Gwen said. "They need the loop disrupters to add new elements to their lives. Even with pseudo-randomness routines built in, the residents will just keep getting themselves into loops, doing the same things over and over."

"Is that so bad?" I said. "The guys playing tennis and the lady on the diving board and the singer at the gazebo are going to do the same things day af-

ter day, whether I'm there to watch them or not. If that's what they really want to do, why should I try to break them out of their loops? They're happy, or at least not unhappy, right?"

"Don't be so naïve," Gwen said. "It's not for them, it's for their families. When Carlo's kids come in from New Jersey to visit, they don't want their dad telling them the same stories he's been repeating for the last ten years. They want to believe their dad is leading a happy, full life here, and that means *change*. New experiences. You have to give the residents something different to talk about."

I'd never had a relative who had enough money to go into one of the VR retirement homes, so I didn't really know too much about the family visits. I guess it made sense, though. If your virtual relative was no more than a static snapshot, who would want to pay to keep him in the Shady Rest? I knew it wasn't cheap.

After lunch, Gwen and I split up, and I walked around the town, looking for places to stick my nose into. At the park, I saw something unusual.

It was a boy, maybe eleven or twelve years old, with a dog. A golden retriever, I think. The dog was unusual because I don't remember seeing any other animals in the Shady Rest before that. The kid was unusual, too, because he was the youngest person I had seen so far.

I had to wonder, was the kid really some old geezer who just enjoyed acting like a kid again? Sure, most of the spooks made themselves appear younger, fitter, prettier, but a twelve-year-old? I couldn't imagine that the dead guy's family would come to visit grandpa at the rest home to find him playing in the park, looking like a little kid.

No, a darker thought crossed my mind. This was probably a *real* kid. Dead, but real. He probably died at a young age, and his parents had him

scanned and put in here so they wouldn't lose him. But that would mean they would grow old, while the boy stayed a kid forever in the rest home. That idea wasn't just sad, it was perverted.

Spooks got to be whatever they wanted to be at the Shady Rest. If he was a kid, a real kid, then why didn't he just make himself out to be an adult? Perhaps because the kid had no experience at being an adult. The older spooks could make themselves appear younger because they had once *been* younger. If this was one of the loops, it was a particularly dismal one.

"That's a nice dog," I said. "What's his name?"

The kid looked at me, then looked away, and I thought for a second he might run away.

"It's okay," I said. "I work here. I thought your dog looked kind of neat, and I don't see too many pets around town."

"It's a she," the boy said, almost making eye-contact with me. "My dog is a she, and her name is Lady."

"Lady. That's a good name. Does she do any tricks?"

"Sure. You wanna see?"

Was that the beginning of a smile I noticed on his face?

"Uh-huh," I said.

The boy took a white Frisbee out of his backpack and flung it away, high and straight. Lady immediately took off after it, and caught up with it. She jumped about 15 feet high, snatched the Frisbee out of the air with her mouth, and did a somersault on the way down, hitting the ground running in the opposite direction, then back to her owner, to lay the disk at the kid's feet. It was, of course, an impossible feat for any dog in the real world.

"Wow," I said. "I've never seen a dog jump that high. Can she do anything else?"

"She can walk on her hind legs," the kid said. "Wanna see?"

"Uh-huh."

The kid pointed to the dog and then waved his finger in the air. The dog leaped onto its hind legs and started walking around, circling the two of us. The dog didn't hop around like a trained circus dog, but walked alternately on each of its back legs, like a person walks. Like no real dog ever could.

"That's amazing," I said. "I'm glad I met you, Lady." The dog reached out a front paw, so I shook it. "And I'm glad I met you," I said, offering my hand to the boy. "I'm Dave Beamon. What's your name?"

The boy looked at my outstretched hand and hesitated. "I'm not supposed to talk to strangers," he said.

"I'm not a stranger," I said. "I'm Dave, and I work here, so you'll be seeing a lot of me. You can shake my hand now or later, but eventually you'll get to know me. Shake?"

The boy was tentative, but he put out his hand. I grasped it firmly and pumped a few times.

"Valentine," the boy mumbled.

"What?"

"That's my name," the boy said. "Valentine."

"You don't sound like you care much for it."

"I hate my name."

"Well, what would you rather be called?"

"I don't know. Nobody's ever asked me that before. How about . . . Butch?"

"Butch is good," I said. "Nice to know you, Butch. Keep teaching Lady new tricks. I'll be seeing you around."

I waved and started walking down to the other end of the park. I looked back and the boy still had his hand outstretched from when I'd shaken it. Yeah, I decided, he was definitely a spook-kid, and not just some old fart playing at being a kid. The adult spooks were so wrapped up in themselves. This kid needed a friend.

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Back in my apartment after work, I had a can of tasteless orange ravioli for dinner, which was a far cry from the great Italian food at Carlo's. Later, my friend Mitch was holding court at the Corner Bar, and I got him to spring for a couple of rounds, promising I'd catch up just as soon as I got my first paycheck.

Mitch told me he and his girlfriend Janine were getting married in eight months. We joked about him not being able to come out to the bars so often after that. He told me about all the silly preparations he had to go through for the wedding. I got him to buy me one last round before he had to leave.

While I finished that last beer, I looked across the room at the group of young, single women who frequented the bar. If only I had that bottomless wallet, like at the Shady Rest. Jeez, now I had to start saving up for a wedding present for Mitch and Janine.

I went home, alone, and fell asleep in front of the holovision.

On my third day at the Shady Rest, I took in a baseball game. Well, part of one. The field was at the far end of the park, and I shared the viewing stand with fifty or so sims. I only stayed for two innings, but they took nearly an hour each.

I bought a hot dog and a beer, and they were both incredibly delicious. The weather was nice, the crowd was as enthusiastic as a bunch of sims could be, and the guy doing the play-by-play on the public address system sounded like a network pro. The problem with the game was that most of the players were too good. The pitchers both threw big heat, but batter after batter ripped line drives into the gaps for singles and doubles or popped them over the fence for homers. It reminded me of an old 2-D cartoon where the players formed a continuous conga line around the bases. Only the presence of a few er-

ror-prone sims on each side allowed the game to progress at all, and the score was 28 to 35 when I left.

Walking around the town, I noted that most of the salespeople, waiters, street sweepers, and other subservient people were sims. They all looked their parts, but some stiffness and single-mindedness about performing their duties made them very easy to spot. Spooks—residents, on the other hand were just as obvious to pick out. Just look for anyone doing something unbelievably well, and there you go. Another tip-off was the way the residents craved recognition for their computer-enhanced accomplishments, and not from sims either, but from real people like me.

I also noticed some other real people—my co-workers—from time to time, looking like ordinary folk scattered among all the stars and mannequins. They didn't usually talk much to me like Gwen did, but when our eyes met there was usually a nod of recognition. We were on the job.

Back at the gazebo, the singing lady had four sims listening raptly to her performance, but her voice picked up noticeably and her smile broadened when I slipped in among her audience. Apparently, the residents could recognize real people just as easily as I could distinguish sims and spooks.

The lady finished a beautiful song I didn't recognize, but I really meant it when I joined the sims in applauding her when she was done.

"Are there any requests from the audience?" she said, staring straight at me.

It was apparent she was addressing me, so I said, "Do you know 'Somewhere' from *West Side Story*?"

"Of course," she said, and began singing it, skillfully handling both the male and female parts. At the points where there should have been two voices, I could actually hear the woman's voice overdubbing itself to

produce the harmonies. It was impossible, but nonetheless pleasant.

"Another request?" she said, directly to me, as I applauded.

"Not right now," I said. "I've got to keep moving. But you're very good. I'll be back."

She smiled sweetly and started singing another song from *West Side Story*, "Tonight," as I began walking off.

At the tennis courts, when the two pros sat down to towel off between games, I let myself onto the court and asked them if they gave lessons.

"Have you played tennis before?" one of them asked.

"Yes, but I'm nowhere near as good as you two," I answered. "I was hoping you could show me how to hit like you do."

The two players, Ron and Mark, jumped up and practically put a racket in my hand. They instantly wanted to know how long I'd been playing, what kind of racket I used, what tension, grip size, Eastern or Western, one or two-handed backhand, what sort of playing surface I preferred, was I a baseliner or did I play serve-and-volley, and would I like a lesson right that very moment?

"Guys, guys, I'm not dressed for it," I said, waving a hand at my long khakis and moccasins.

"You can change your outfit to whatever you need, just by thinking about it," a familiar voice said from behind me. It was Gwen, and she was sitting on the bench outside the fence. "Why don't you give it a try?"

"I don't know how," I began to say, but when I looked down, I was wearing tennis shorts and sneakers.

"Okay," Ron said, "let's hit. Forehands first."

I walked to one side of the court and the guys both took the opposite side, producing a large hopper filled with yellow balls. I stood at the baseline near the center service mark and

they started firing balls at my forehand with the precision of a practice machine.

Ron and Mark shouted commands: bend at the knees, racket up, keep your wrist firm, swing low to high, take it on the rise, crosscourt, down the line, now backhands. The time went so fast, and I must have hit hundreds of balls in a relatively short time, but I was actually starting to get better. I didn't know if the experience in VR would translate to a better game in the real world, but here, coached by these two pros, I was hitting harder and straighter than I ever had before.

"Wanna play a set?" I called, overconfident in my newly found skills.

The two guys looked at each other and suppressed a laugh. Mark said, "You take it," and sat down on the courtside bench to watch. I started to pick up the many balls scattered on my side of the court, but in an instant they were gone, and only three lay in a row near the service line.

"Let's just play a tie-breaker," Ron said. "You serve."

I whacked my first one in for an ace. We had several long rallies, and I was really feeling good about how I was moving and hitting the ball, and before I knew it, I was leading 5-0. Two more points and the tiebreaker was mine.

Ron reeled off seven straight points, aching every one of his serves, and returning each of my serves with a blistering winner. I lost 7-5. Of course, he had been toying with me the whole time, and could just as easily have beaten me 7-0. I was gracious and jumped the net to shake his hand, thanking him for the lesson. Gwen applauded us both from the sideline.

"I'm going to have to take a shower now," I said to her, "and I guess I'll be a little sore in the morning."

"You are joking, right?" she answered.

"Um. . . ."

"Humph—beginners," she said. "Just wish yourself cleaned up and back in your street clothes."

I shut my eyes and thought about what I had been wearing before the game. When I opened them, sure enough, I was back in my khakis. This was just too easy.

Gwen and I walked past the swimming pool, where the lady on the diving board did a perfect triple with a couple of twists. I showed her a thumbs-up as she exited the water, and she waved back and gave me a shy smile.

"You should talk to her," Gwen said. "She spends all day on that diving board. I don't think she ever leaves the pool area."

"Well, right now I'm talking to you," I said.

"I don't really count."

Gwen took me to a sandwich shop. No surprise there—the sandwiches were outstanding. I pointed to the guy behind the counter and said, "He looks too lifelike to be a sim, but why would a spook want to be a sandwich guy?"

"He bakes the bread himself," Gwen said. "He roasts the beef and turkey, and smokes the ham. All in the little kitchen in back. He grows most of the vegetables in his back yard, too. You heard of Danny's Sub Shops? He's Danny."

Danny's was a big national chain. I never knew there was an actual "Danny" before. Live and learn.

"Real nice sandwiches," I called out to Danny.

Danny nodded at me from behind the counter. He already knew.

"Everything is so perfect here," I said. "Don't you ever get tired of all this perfection?"

"Sure," she replied. "A loop is a loop, even if it's a pleasant one."

"How long have you been doing this?"

Gwen gave a little laugh. "Too

long."

"Well, I'm not fixing to make a career at this," I said. "Maybe for a year or so, but right now I need the paycheck. So how long is too long?" I pressed for an answer.

Gwen paused before replying, "Sometimes it feels like forever. I don't know how much longer I can keep on doing this."

It occurred to me then that Gwen might not be the same person as she appeared to me. If you could be *anything* you wanted in the Shady Rest, then the person I knew as Gwen could be someone completely different in real life. Here in VR, she looked to be about twenty-five years old or so, just a bit older than I, but if she had really been doing this a long time, surely she would have to be older than that.

This was only my third day on the job, and I was glad to have made such a good friend—a friend I might want to ask out, perhaps, on a date after work—but now I was all confused. It was probable that Gwen was older than she looked. Perhaps much older. And if this plain-Jane exterior was what she wore in VR, who knew what she *really* looked like on the outside? It could be a lot worse.

But here in the Shady Rest, she was a friend, and I knew I should respect her for however she chose to appear, just as I was supposed to respect the spooks. Even if they all opted to be young, pretty, athletic, and ultimately shallow, who was I to judge?

"Cheer up," I said. "I didn't mean you should quit your job or anything."

"It's all right, Dave. Sometimes I just wonder if it's still worth the effort."

"Well, at least it's a living, right?"

Gwen winked at me and finished her sandwich. She could be a very attractive woman, no matter what her real age or appearance.

After work, back in Queens, I went

straight to the Corner Bar, so I could nurse a beer while filling up on the happy hour snacks. I thought Mitch might show up to lend some support, but he never did. I was scraping the bottom of the barrel financially, but I managed to buy a drink for one of the regular young beauties when she looked my way with the merest hint of interest. Call it an investment.

Her name was Helen, and we talked for a few minutes, but both of us knew quickly that we were hopelessly mismatched. Religion, politics, music, sports, food, whatever the subject, we both disagreed completely. We even argued about the weather. My investment did not pan out.

Walking back home, I thought about how much easier, how much *better* everything was at the Shady Rest. If only real life could be as good. I was home by nine o'clock, and asleep by nine-thirty.

On Thursday, I took another tennis lesson from Ron and Mark. I played a tiebreaker with Mark, and he beat me 7-2, but I think I really won those two points legitimately. It was a start.

At the gazebo, I spoke with the lady singer. Her name was Diane, and she had always wanted to be a Broadway actress when she was alive. I told her she ought to put a band together to help flesh out her numbers, but she insisted that her voice was good enough all by itself. I asked her if she played tennis. She didn't know—she had never tried it before.

Later, I met Gwen, and she took me to an ice-skating rink. The ice was filled with a couple of dozen sims, circling endlessly, so I wondered why she had brought me there. I wasn't very good at skating, so we just sat in the stands overlooking the ice and watched for a while. Eventually, the ice cleared, and a thin, young man wearing a flashy costume skated out. The room darkened, and a spotlight

appeared out of nowhere to follow the man around the rink. He gave an Olympic-level performance, five minutes packed with triple and quad jumps, dizzying spins, and fancy footwork, while an inspiring soundtrack played.

When he finished his final scratch spin and took a bow, the sims around the rink threw bouquets on the ice. Two young female sims came onto the ice to gather up the flowers and deliver them to the man, who took up a bench on the far side of the rink. A series of numbers flashed on a scoreboard above—judges' scores, mostly 5.9s and 6.0s—and the man waved to the cheering crowd of sims.

"He's very good," I said. "Does he do this every day?"

"Every day," Gwen said, nodding.

"This is totally ridiculous for a neighborhood rink like this. He really needs some help."

"Yes, he does. That's why I brought you here. I've talked to him a few times, but he didn't pay much attention to me. I think he . . . prefers male friends."

The spotlight went out and the house lights came up. The young skater was gone, and the sims started filing back onto the ice, to resume their endless circles.

"I'll have to catch up with him another day," I said. "Today, I'd like to talk to you."

"Okay, what would you like to know?" Gwen said.

"Well, I haven't been working here very long, but I already know you're a good person. Is there any chance that you and I could maybe get together for dinner or something? I mean on the outside, after work."

Gwen looked mortified. It wasn't the reaction I had been expecting. She just stared at me without replying.

"So what do you say?" I asked. "Would you go out with me?"

"That wouldn't be a good idea."

"Why not?"

"How do you know I'm not married?"

"You're not wearing a ring. You don't *look* like a married woman."

"Looks don't mean anything in here. You know that. You have no idea what I'm really like."

"I'm guessing you look a lot like what I'm seeing now. Maybe a bit older, since you seem a lot more experienced, but that's okay with me. I know the kind of *person* you are."

"Dave, you're a sweet boy, but I don't think so."

My life story. In the real world, Gwen might be old, unattractive, horribly disfigured, or handicapped. I was willing to take a big chance on her and offer the invitation, but just like at the Corner Bar, here I was again, shot down. I suppose she could have been married, or perhaps lesbian, but I didn't think so. No, it was something else. Something that didn't include me.

Gwen and I went our separate ways outside the rink. I was in a funk and went to the park to walk it off, when I ran into Butch and his dog. The boy made some hand signals and Lady bounced a ball on her nose. Despite the dog's antics, Butch didn't look very happy. Just what I needed to cheer me up—someone even sadder than I was.

"You're pretty good with that dog," I said. "Hey, maybe you could train guide dogs for the blind or something."

Butch looked at me briefly, then turned his attention back to the dog, ignoring the remark. It was a stupid thing for me to have said. There were no blind people here, and no other dogs. What was I thinking?

I needed to say something smart for a change. Definitely not something stupid like, "Hey kid, what do you want to be when you grow up?" Butch wasn't going to grow up, ever. He was

dead, and his folks had put him here in this horrible place with some sim dog that performed stupid tricks he commanded, every day until the money ran out and someone pulled the plug.

Maybe the Shady Rest was really hell.

After my shift, I went to the Corner Bar and filled up on some free hot wings, for the price of a beer at happy hour. I wondered why they called it happy hour when all I could think about was how miserable I was.

My friend Mitch didn't show up that night. He was probably out somewhere with his fiancée, Janine, picking out the boutonniere or some other such nonsense for the upcoming wedding. At some point during the night, Helen, the young lady with whom I have absolutely nothing in common, came in with some new guy in tow. He looked like a nice guy. I'm sure he and I have absolutely nothing in common either.

Friday was payday, so if nothing else, I knew I'd have some money by the end of the day. I took another tennis lesson from Mark and Ron, and when I played a tiebreaker with Ron, I won 7-5.

"Thank you for letting me win," I said. "But we both know I couldn't really beat you if you were trying."

"I want to make sure you'll keep coming back," Ron said.

At the pool, I wished myself into a bathing suit and took a swim. The water was crystal-clear and blood-warm. I swam over to the deep end so I could talk to the woman on the diving board. Her name was Kara and she had broken her neck diving into a flooded quarry when she was sixteen years old, then spent the remainder of her life in a wheelchair. Her family put her in the Shady Rest to give her the life she never had.

"But don't you get tired of just diving all day?" I asked. "This can't be the life you really wanted."

"I sat in that wheelchair for fifty years," Kara said, "replaying that dive over and over in my head. I kept thinking that if I had been a better diver, things might have turned out differently."

"Have you ever tried playing tennis?" I asked. She didn't say yes, but I knew she was thinking about it when I left her.

Later on, at lunch in a Mexican restaurant with food you wouldn't believe possible, I asked Gwen for her telephone number.

"Please don't start that again," Gwen said.

"Is there some reason we can't be friends on the outside?" I asked.

Gwen fell silent. I think that was when I started getting suspicious. Not that she was married, old, ugly, or anything like that. I started wondering if she was really an employee like me, or a spook. I had just assumed all along that she was a real person because she wasn't strikingly beautiful, athletic, and skilled like the other spooks. They were all that way because that was how they saw themselves, how they wanted to be. If Gwen were a spook, she didn't come across like one because she didn't want to look any different than the plain but sincere person she was. Was it possible that a spook wouldn't *want* to change themselves at all?

Butch, the boy with the dog, was a spook, and he didn't try to pretend he was anything but a scared and lonely kid. Perhaps he couldn't. Maybe Gwen was the same way.

Or maybe I was just thinking too much, searching for some reason why this person I liked didn't want to have anything to do with me outside of work. As if her rejecting me could only mean she was not really human. Of course, plenty of real, living human

females had shot me down, some quite recently in fact, so it wasn't as if being among the living gave any more likelihood that a woman would have anything to do with me, but I was grasping at straws.

"You ought to go to church," Gwen said, while my mind was still spinning on whether she was real or a spook. "Maybe you'll find what you're looking for there."

I wasn't a religious person, and hadn't been to church since grade school. Unless things had changed a lot since then, church was not the place for the answers to the questions I was asking.

After lunch, I went to the baseball field and finished my shift by sitting in the stands with the sims through five excruciatingly long innings. Every time the beer-sim came by, I bought another round—five large ones, the best beer I've ever tasted. Frosty, foamy and full of malt, they went down smoothly. With that much beer, my back teeth should have been floating, and I should have been feeling some kind of buzz, but neither happened.

The good news is that, yes, there is beer in heaven. The bad news is that, no, you can't get drunk.

After work, I asked my supervisor if I could get some info on one of the residents, so I could better understand her and help bring her out of her shell. The supervisor was glad I was taking such an interest in my work and produced a single datasheet on my request. The resident was Gwen Marzetti. She really was a spook, not an employee. The sheet didn't say much: date of birth, last address while alive, cause of death. Gwen had died at the age of twenty-six of ovarian cancer, over fifteen years ago. I jotted the sketchy info down on a scrap of paper before giving the datasheet back to the supervisor.

On the way home, I stopped at a

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cash machine and was briefly happy that my account now had a week's salary deposited in it. I withdrew some and headed for the Corner Bar. Mitch didn't show up that night, but I was able to keep myself occupied by celebrating the fact that I had some money in my pocket and drinking a few beers. More than a few, in fact, and real beer—the kind that makes you drunk, not the virtual beer that doesn't do anything, like in the Shady Rest.

When the regular gaggle of young women showed up a bit later, I bought them a lot of drinks, too, and tried to pick up a few of them. Well, all of them, actually. At the same time. I think. The girls were laughing at me, and I was so sloppy drunk by then, I laughed along with them, not realizing I was the butt of their jokes. One by one, they moved away from where I was sitting, and I found myself alone again, in the crowded bar.

Hooray for the weekend.

Saturday morning, after my head stopped throbbing, I was able to go to the supermarket and buy some things to stock up my refrigerator. No more ramen noodles for a while, I vowed. It was good to have some money for a change. I called Mitch to see if he wanted to meet somewhere for lunch, my treat, but he had something planned with his fiancée. He told me to come by his place for dinner, though. He was having some people over.

I didn't have anything to do for the rest of the day, so I went in to the Shady Rest to put in some extra hours. Unpaid, of course, but it might get me ahead to show some interest in my work. It was better than sitting around the apartment watching holovision.

At the Shady Rest, I found Diane singing in the park, as usual. She asked if I had any requests, and I did.

"Let's play tennis," I said.

Before hitting the courts, I took Diane to the pool and introduced her to Kara, who was still practicing her dives. I got her to agree to come with us to the courts, too. Mark and Ron were slugging it out, as usual, and I told them Diane and Kara wanted to learn tennis and needed some lessons. The two guys fell all over themselves showing the ladies how to play. After some basics, they paired off for a set of mixed doubles. It could have been ugly, if the guys treated the newcomers like they had treated me that first time, but they were pulling all their shots to make it as easy as possible for the ladies. I think all four of them were having a pretty good time.

While I was watching them play, Gwen came along and sat down beside me.

"Here's something new," she said, looking at the foursome on the court. "Is this your doing?"

"Yep. I thought they could use a change."

"That's what you're here for," Gwen said. "And on a Saturday! What are you doing here today?"

I could have asked her the same thing, since she was pretending to be an employee. But I didn't.

"I like it here," I said, staring hard into her eyes. "Some of my best friends live here."

"I know what you mean," she said, looking away. "You become attached to some of these people after a while."

I kept staring at her, waiting for her to make eye contact again, before telling her, "I know about you."

Gwen let out an almost inaudible, nervous laugh. "What do you know about me?"

"I know that you're a resident."

Silence.

"And I still like you a lot," I added.

"Well, I guess that's part of your job, right?"

"I just have to interact with the spooks," I said. "I don't have to like

them. Besides, I'm off the clock today, and I still think you're pretty nice. I would have really liked to know you when you were alive, but I'd like to stay friends with you here, if you'll keep seeing me."

"I don't see how I could avoid it. I'm always here, you know."

She didn't cry, but I could swear her eyes grew teary.

"Thanks," I said. "I'll see you around, then. But now, I have to go mingle. It's my job."

"Yes, I know."

In the park, I met up with Butch, and invited him to have an ice cream. He was still leery about going off with me, though.

"I'm not supposed to go anywhere with strangers," he said.

"I can't be a stranger forever," I said, "unless you choose to keep me one."

He followed me to a soda shop a block away, and I told him to leave Lady outside. We shared a small table and ate hot fudge sundaes. They were delicious, just as I expected.

We talked. Butch had been eleven years old when he died from asthma. He had been eleven years old for the past seventeen years here at the Shady Rest. His parents still visited once in a while, but they were getting old and it didn't make them happy to see him. I asked him where he stayed when he wasn't playing in the park, but he didn't have an answer for that. There was no answer because he *didn't* go anywhere else. He just played in the park with Lady, all the time. After some questioning, he admitted that he missed going to school and having other kids to play with. I told him I'd play with him, but we both knew that would be awkward for a grown man and a boy.

He needed some change in his life. Something more than just sharing an ice cream with a paid employee.

After finishing up at the Shady Rest,

I went over to Mitch's apartment for his dinner party. Besides Mitch and Janine, there was one other couple, and one unpaired young woman, who I was seated next to. It was obviously a fix-up, but the woman wasn't half bad looking.

Over the course of dinner, Mitch and Janine were working hard to draw the woman and me into conversation, but there was just no spark there. She was attractive, and interesting enough, but neither one of us made the sort of eye contact or light flirtation that said there was going to be more after this.

After dessert and coffee, she made some lame apology and left. The other couple soon followed.

"Don't worry, Dave," Janine said. "We'll find the right woman for you eventually."

"It's okay," I said. "I may have already found someone."

"Really!" Mitch said. "That's great. Well, bring her around sometime."

"Sure," I said. "Sometime."

I had nothing going on Sunday morning, so I went to the Shady Rest. I liked being there. Things were better there than in the real world. Maybe I liked it too much. Before plugging in, I asked the shift supervisor if it was unusual for a new employee to spend so much time with the residents. He said working in a VR world was just like a candy shop to newbies. If you let the new employees have as much candy as they wanted, they soon got sick of it and got back to work.

In the Shady Rest, I heard the pealing of church bells, and followed the sound to a pretty little chapel with stained glass windows. I'm not much of a churchgoer, but I decided to see what was going on. Inside, an usher-sim tried to lead me to a pew in the front, but I was not happy about that. If I wanted to bail out early, it would be a bit noticeable up front, so I ignored the sim and took a seat in the

back row.

Before the service started, I looked around and saw lots of familiar faces from town. Most of the faithful were spooks, not sims; although in here they looked older and more distinguished, and dressed a lot more conservatively in suits and dresses. Organ music began playing, sounding out of place with the heavy timbre of a massive pipe organ in the modest-sized hall. There was no actual choir, but the entire congregation around me sang the hymns, and they sounded very good.

The minister gave a rousing and compassionate sermon, making eye contact with me often. He recognized I was new here, and seemingly delivered the sermon directly at me. Words about God, love, forgiveness, and all the usual religious buzzwords, but this time it made sense. Rather than feel uncomfortable about being singled out, I was inspired. Just like the other spooks in this town, the minister needed an audience for his performance, and I was happy to comply.

Looking about, I noticed Gwen was sitting in one of the front pews, listening to the sermon with rapt attention. She looked the same as she always did, neither younger or older in appearance, and wearing the same sort of plain clothing she always had. Either she was a fairly unimaginative spook, or this was how she *always* looked—how she must have really looked in life. Even in VR, she was no phony, and I admired her for it.

After church, I left the Shady Rest and decided to get some exercise. Real exercise, so my muscles wouldn't atrophy from all the time spent in a VR cubicle. I wanted to see if the tennis lessons from Mark and Ron would translate to useable skills on a real court, so I went to a park where I knew I could always find a pick-up game. I wound up filling out a spot in

a game of mixed doubles, paired with an attractive young woman named Marie, against an older married couple. Marie had just moved into Queens a few months earlier, and was working on Wall Street as a bond trader. She didn't flinch when I told her I worked with spooks in a VR home, keeping them from falling into loops. Instead, she seemed genuinely interested.

During the game, I felt like I had a bit of extra zip on the ball, and we beat the other couple easily. Marie and I didn't have all that much time to talk, but we exchanged phone numbers, in case either one of us was stuck for a tennis partner in the future. It was a modest beginning, but it was something.

Back at work on Monday, I listened to Diane sing her Broadway show tunes at the gazebo. She saw me and started singing "Somewhere." I don't have a very good voice, but I tried to sing the male harmonies along with her, and she perked up a bit when I joined in. It was a change for her, having another voice to sing with.

Change was good.

"Thanks for taking me to the tennis courts the other day," she said, after the song was over. "It was different."

"You ought to go to the church next Sunday," I told her. "The people singing the hymns sound good, but a great voice like yours could lead the congregation, and I think you might sound even better with the others."

She scrunched up her face, but I thought she might come to church if I was there to bring her over and introduce her. I told her to expect me on Sunday morning.

I wandered around town looking for more places, more lives where I could make a difference. In another part of the park, Lady was doing tricks with Butch, as usual. I played with the boy for a while, tossing a Frisbee back and forth, but playing wasn't really what

he needed. He already played all the time, but what else could a grown man do with an eleven-year-old?

Later, I had lunch with Gwen at Carlo's again, and the saltimbocca was every bit as good as she had said.

"I saw you in church yesterday," I said, over dessert.

"Are you stalking me, or what?" she said.

"You were the one who said I ought to go to church," I replied.

"I meant a real church on the outside, not in here."

"Well, it was a nice church, and I sorta enjoyed it."

"Church is not for entertainment," she said sternly. "If you want to be entertained, why don't you go to a movie?"

"I'll go if you come with me," I said. "How about tonight?"

Gwen looked strangely at me. "You're not here at night."

"I could be," I said.

"You're already spending way too much time here," Gwen said. "After you've been around awhile, you'll get bored. Everybody does."

"Not with you."

"Oh, please. Stop acting like some lovestruck teenager, will you?"

"Does that mean you won't go to the movies with me?"

Gwen made a what-am-I-gonna-do-with-you face and said, "Yeah, I'll go to the movies. It's been a while since I've seen one."

"Good," I said. "Then it's a date."

After my shift was over, instead of going home, I ate a lousy dinner at a local Italian place where the pizza was flat, rubbery, and greasy, but real. I still needed real food, although it would never again taste quite the same. After wolfing down a couple of slices and a soda, I went back to the Shady Rest and plugged in.

Gwen was waiting for me in front of the local movie house, a smallish the-

ater with only three screens. I thought Gwen might have dressed up a bit for an evening out, but she showed up in the same conservative clothes she had worn earlier in the day.

I expected that movies at the Shady Rest would be like everything else—the best ever—but was disappointed when the marquee showed titles of current, *real* movies. There was an action movie, a comedy, and a romance. I picked the romance. Hey, it was a date, right?

The movie stank, but the popcorn was incredible. A couple of times during the movie, I tried to hold Gwen's hand, but she playfully slapped my wrist whenever I tried it. I put my arm over her shoulder at one point, but I could feel her stiffen, so I removed it.

There was one mild sex scene during the movie, and I looked at Gwen to see how she was reacting to it. She averted her eyes from the screen and just gazed at the bucket of popcorn the whole time. I grabbed her hand on the armrest and squeezed it, but she just let her hand drop away onto her lap. After the movie, I asked if she wanted to go someplace for a drink, but she said no. I asked if I could walk her home, but she said it would be better if I left then. So I did, popping out of VR right in front of the theater.

Some enchanted evening, huh?

At home I lay awake, confused, for several hours before I was finally able to fall asleep. I don't usually remember my dreams, but this one stayed in my mind long after I awoke: I was back at NYU and late for an exam, but couldn't find the right classroom. It was a fairly common anxiety nightmare, as I knew from my psych classes, but this time I found the classroom at the last minute and entered just as the exam was beginning. There at the front of the classroom was the professor, but it wasn't any of my regular teachers. He was my age and familiar, but someone

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I knew from someplace else, dressed in a professor's ceremonial gown and wearing a mortarboard. I couldn't quite place the face.

The young professor wasn't handing out test booklets, but diplomas.

* At the foot of the lectern was a dog, a golden retriever, wagging its tail.

"Lady?" I asked.

"Congratulations," the dog said. "It's graduation day."

I looked down and saw that I, too, was wearing robes and a mortarboard. The professor thrust a scroll tied with a blue ribbon at me and I reached out to take it.

I realized who the professor was as I moved the tassel on my mortarboard to the other side. No wonder I didn't recognize him—he was all grown up in the dream.

The Shady Rest has a directory, a book on a pedestal in the village square, which lists all the residents and businesses in the community. At the start of my shift on Tuesday morning, I looked up Gwen Marzetti's address, 26 Locust Avenue, and took a walk there. Most of the houses in the Shady Rest were large and ornate, reflecting the owners' tastes, but 26 Locust Avenue was Spartan in comparison. It was a tiny blue bungalow, with a couple of shrubs on either side. Near the door was a single stalk of trumpet-shaped white lilies. I knocked on the door.

Gwen answered, wearing the same plain clothing as always. I wasn't exactly expecting her to answer the door in a nightgown, but I was beginning to think she was stuck in a bit of a loop with her appearance. Maybe it was a minor loop that I could break her out of.

The inside of Gwen's bungalow was very austere. It was basically one room, with a tiny kitchenette tucked into one corner, a small table with two chairs, a daybed, a floor lamp, and a

modest bookshelf. Even the walls were bare, with only a simple crucifix and a cheap print of da Vinci's "Madonna And Child" to give any relief from the plain white surfaces.

"What are you doing here?" she asked.

"I work here," I said. "And good morning to you, too. Invite me in."

Gwen stepped aside and waved me in, but her face showed annoyance.

I walked over to the small table and sat in the chair that looked least used, figuring the other was where she regularly sat. The Formica table was bare except for simple salt and pepper shakers. Gwen sat in the other chair.

"I've been thinking about last night," I said. "I'm not exactly sure what happened, but I wanted to make sure everything is still all right with us."

"All right? Yeah, I guess," she said.

"Um, all right in what respect?"

"Well, you know I like you a lot, and I thought you liked me, too, but I don't think you had a very good time with me last night."

"It wasn't a very good movie," she said.

"But you seemed so standoffish. Gwen, I think I . . . I hope I'm not moving too fast for you."

Gwen got up from the chair and walked over to the sink. She took a glass from the drying rack and filled it from the faucet and drank, all the while just staring at me.

"Aren't you going to say something?" I said.

"I'm not sure what to say."

"How do you feel about me?" I asked.

"Dave, you're a nice guy. A *real* nice guy. But I'm just a spook, to use your term. I'm afraid you're spending too much time here in the Shady Rest and confusing this VR life with the real world."

"I like it here," I said. "In a lot of ways, it's better than the real world."

"But it's *not* the real world, and I don't want to lead you on that you can have some sort of normal life with me in here. Go out and get yourself a real girlfriend, if that's what you're looking for."

"But I like *you*. I want to be with you and know everything about you. You're more real to me than all those phony girls on the outside. Would it be so unusual for you to be my girlfriend?"

"I know it's your job to entertain us spooks," Gwen said, "but this is not how you're supposed to keep us entertained. I don't mean this in an insulting way, but go get a life. Keep what's *real* real."

I left, mumbling something about staying friends. For the rest of my shift, I walked around the Shady Rest in a daze. I think I spent most of the afternoon watching baseball.

After my shift was over, I took the subway down to Bowling Green, then got on the ferry. On the Staten Island side, I grabbed a cab and had the driver run me past the address I had copied down from Gwen Marzetti's datasheet—her last address while she was alive. On the trip over, I felt like a stupid teenager, haunting the home of an ex-girlfriend, hoping for a glimpse of her through a window or something. It was a stupid thing to do. I'm not proud.

The cab pulled to the curb in front of the address. It was a convent. The Sisters Of Mercy.

When I first met Gwen, I had asked her if she worked at the Shady Rest, and she had said yes. Perhaps I was one of her good works. The Sisters Of Mercy. And me, I suppose, a mercy case.

"Are you going to get out?" The cabby asked, jarring me from my thoughts.

"No. Take me to Queens," I said. "There's a place called the Corner

Bar. . . ."

I didn't go looking for Gwen right away on Wednesday. Tennis, baseball, the pool, the gazebo, just walking around, I visited most of the usual places and interacted with the spooks. Gwen never showed up, so later in the day I went to her bungalow.

There was no answer when I knocked, but I tried the knob and the door was open. Was there any reason to lock a door in the Shady Rest? I called out Gwen's name, but from the threshold I could see the whole place and it was empty. On the little table was a single sheet of paper, so I walked over and read it:

Dear Dave,

Sorry I wasn't here to tell you in person, but it's better to make a quick break of it. You said you wanted to be with me, but I can't allow that to happen. You are a good person and you deserve a real partner in the world of the living.

You also said you wanted to know all about me. I can tell you I never wanted to be in the Shady Rest. I was in my mid-twenties when I died, and my well-meaning parents thought they were doing me a favor by having me scanned and put in here. If I had been conscious at the time, I'd have never let them do it.

Once I found myself here, I often thought about pulling the plug on myself. I never wanted to be here, and my religious beliefs led me to think that dying was not necessarily a bad thing if you led a good life. I tried to do good works and make myself useful in life, so death did not frighten me nearly as much as it did my parents. I was looking forward to seeing what came next, but the Shady Rest wasn't what I was expecting.

After thinking things through, I began to wonder if I might not do good

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works here in the Shady Rest—that perhaps I was here for another reason. Certainly, there were a lot of residents here who needed help. Employees like you come and go, and sometimes they make a difference in breaking the residents free from their loops, but other times the employees just become another part of their loops.

Dave, I think I was becoming part of your loop.

Residents can voluntarily have themselves turned off if they don't find this virtual life worth living. My religious beliefs tell me that suicide is a sin, but I've already been dead for some time now, and don't worry about the pain of dying a second time—it's just a matter of unloading some software. One minute I'm here, the next, gone. Nice and clean with no pain, no suffering.

If you think of me at all, think of someone who tried to make a difference in peoples' lives. If I made a difference in yours, hold on to the memory, but get on with your life. Your real life. Break out of your loop, do good work, lead a good life, and maybe we'll meet again in the next one. Goodbye.

Love,

Sister Gwen Marzetti

I almost quit my job at the Shady Rest that day. I walked around town for a while, wondering what to do next. Then I saw Butch, playing fetch with his dog in the park.

"Hey Butch, come along with me," I called.

"Where are we going?"

"Your place."

"My place?" he said, puzzled.

"Where's that?"

"Twenty-six Locust Avenue. It's a nice little house I found for you. I think you'll like it a lot."

"What's there?"

I thought about what *ought* to be

there. Butch was eleven years old. That's sixth grade in school. What ought to be there were seventh-grade textbooks in math, English, social studies, and the like. I would find out what he required, and help him use them properly, to learn what he needed to learn. I would help him to look the way he needed to look, so he could grow to be a seventh-grader. And then an eighth-grader. And then high-school. Maybe even some college level material, but if I could bring him along to the point of becoming accepted as a young adult instead of a little kid, maybe his life here might be a bit better.

"Everything you need will be there," I told him. "We just have to figure out the right things to wish for."

"You're a nice man," he said. "I wish you were my dad."

After work, I went home, cooked myself an actual meal that didn't come from a can, and looked up the seventh-grade syllabus from one of the local middle schools on the Net. I thought about going out to the Corner Bar for a while, but decided to just stay in for the night.

Even though it was only Wednesday, I was wishing it was the weekend so I could go to the tennis courts—the real tennis courts—and hit a ball around some. I needed the exercise. I called up that woman I met last week, Marie, and asked if she was coming out to the courts this weekend.

She was. ■

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take unexpected forms.

i.

Creation screamed. Neutrinos were the first heralds of disaster. Closing on them in a race that would span the radius of the universe was a dragon's breath of gamma and x-rays. Following at a speed of a million kilometers an hour, yet dropping ever further behind, came the ionized gases that were, save for the black hole growing at the center of the conflagration, all that remained of Betelgeuse.

The Endeavor flew ahead of the expanding incandescence, searching vainly for haven.

ii.

Death was not at all the way Alex Raymond had imagined it. On the one hand, he had considered the very real possibility of personal obliteration, in which case he should not be around to experience confusion or anything else. On the other, since his uncle had raised him in a very traditional manner, there had been the promise of the Beatific Vision.

Instead of either, there had been an almost unbearable burst of pain and nausea, subsiding after an immeasurable time into a chaotic flood of sound and

images and sensory impressions for which he did not even have a name. There were no eyelids to shut, no hands to cover his ears. Slowly, though, he realized that he could center his attention on one image and its attendant sensory data. The other input still existed, but he was able to ignore it.

He focused on a room filled with people he knew: First Officer Horner; Chief Engineer Fu; Professor Crawford, the expedition's lead astronomer; Neelam Chandra, head of hydroponics and waste recycling; and Brendan MacIntyre, who ran the shops. A door opened, and Captain Kalfus entered the conference room.

"Ten-shun!" Horner called out.

They straightened to attention, always a problematic exercise in micro gravity. If you were not careful, you could kick yourself into the ceiling, to the restrained mirth of all.

"As you were."

The door sealed and locked itself behind him.

"The purpose of this meeting is to assess the cause and extent of the damage to the *Endeavor* and then to determine the most expeditious means of recovery. We will hear first from Mr. Fu."

Memories trickled into Alex's consciousness. The *Endeavor* was a starship. He was, had been, one of its complement of astronomers. Their voyage to Betelgeuse had taken more than two years. Something had happened. . .

The chief engineer grimaced resentfully as he stood up, as if sure that he would get the lion's share of the blame no matter what he said. "At 0704, the *Endeavor's* protective Space¹ bubble underwent a femtosecond power fluctuation. The radius of the bubble contracted, in places becoming coincident with the hull. Those areas underwent the primary stages of Space⁴ dissolution. The safeties cut in, automatically dropping the ship into normal space.

"I have not been able to determine the cause of the power drop. I note, however, that the entire drive system is scheduled for overhaul every six months. The last maintenance was scheduled for our time in the Betelgeuse system. Our unexpectedly hasty departure prevented its accomplishment.

"At the present time, we cannot maintain the Space¹ bubble which makes travel in either Space³ or Space⁴ possible. I would strongly advise against attempting to achieve Space² under any but the most extreme emergencies.

"The good news is that Ms. Meyerson-Nagata has completed an external assessment of the hull degradation. Based on her findings, I estimate that we should be able to restore the system to full operational capacity in sixty hours."

Kalfus nodded. "That delay should be no problem at all, should it, Professor Crawford?"

"Ah, no, sir." The chief astronomer stood and surveyed them all nervously. "We were in Space⁴ for a little more than sixteen hours. During that time, we traveled just under half a light year. We could take 170 days, more or less, to make our repairs before the supernova caught up with us."

Relief around the table was palpable.

"But we still have the increased strain

on the food supply and recycling system to deal with," Neelam Chandra said.

After the drive system, Chandra's section was the most important part of the starship, if the least exciting and, so it seemed to her, the most often criticized. Even with most of the crew in cold sleep for most of the voyage, there was no way the *Endeavor* could carry provisions sufficient for a voyage that would last six years. Water, of course, would have to be recovered. Solid waste had to be recycled as well. In Chandra's section, it was sterilized and broken down into basic constituents. These flowed through hydroponics where they became the nutrients for grains, potatoes, lettuces, tomatoes, and various other vegetables. Lobsters, shrimp, and catfish made their homes in the huge water tanks which, lining the hull, served also as additional radiation shielding.

There were limits to what could be accomplished. The breads and pastas were excellent. The fake hamburger was decent, but there was no point in even trying to counterfeit steak. Still, there was enough variety in juices and sauces to keep the crew happy as well as healthy.

Alex was suddenly filled with an overwhelming longing for the sheer physicality of existence. He wanted to feel air brushing across his skin, to smell newly cooked bread.

"The *Endeavor* was designed for a complement of eighty," Chandra continued.

"Through most of the journey, the majority of these would be in cold sleep. Only in the vicinity of Betelgeuse were all of us to be conscious at the same time. During that period, we would be consuming food faster than we would be able to recycle it, but we would have built up such a larder that there would be no shortage.

"Things have changed. Thirty of our cold sleep capsules are occupied by Genenhu."

Genenhu. He should recognize that

word. If only he could remember . . . But Chandra was still speaking, disrupting his train of thought.

"Members of our crew are in the remaining fifty. That leaves a continuing active presence of fifty-nine. The system is set to continuously sustain about twenty.

"I have already made changes to accelerate the oxygen/carbon dioxide exchange. I will soon be able increase the water recycling rate. So we will be able to breathe and drink.

"Food is another matter. If we shorten the current process sufficiently to feed our current complement, I will be able to provide nothing beyond a watery gruel."

"Nutritious gruel, I should hope?" Kalfus said.

"I think so," Chandra said, after a surprising moment of hesitation. "I will have to refine my figures. But even if so, it will have a detrimental effect on morale, added to the constant stress of being conscious in Space⁴."

"True enough." Kalfus turned to the other side of the table. "Mr. MacIntyre, above the entrance to the shops is a motto which I believe you put there: 'From a sow's ear, a silk purse.' We need more cold sleep capsules and/or an augmented recycling system. Can you make good your boast?"

"Absolutely, sir," MacIntyre said stoutly, "but we need the sow's ear first. I was running some quick-sims on my notebook while you were talking to Ms. Chandra. We have the plans for both cold sleep capsules and for any extensions we might want to make to the hydroponics and recycling system. Our facs systems have the ability to form all necessary parts. But we're not quite alchemists: we can't transmute elements and we certainly can't create what we want *ex nihilo*. For example, if we took down the entire recycling system, we would have the raw materials for the necessary number of cold sleep capsules. Or we could reduce all the cold

sleep capsules to their basic constituents, and we would have enough for the enlargement of the recycling system. If neither of those possibilities appeal to you, we could cannibalize our shuttles and hope we have no further need of them.

"The bottom line is that the piper must be paid for whatever we fabricate. Choosing who will pay and how is above my pay grade."

"Quite so," Kalfus agreed. "Prepare for me a detailed set of trade-off scenarios such as those you mentioned. If we use only a skeleton crew, we could shut down most of the ship and so get by with a diminished recycling capacity."

There was another alternative, but there was no point in considering it. Nobody could stand two and a half years in Space⁴.

"In the meantime, you need more stuff to work with," Kalfus said. "Where can we find 'stuff,' Professor Crawford?"

The senior astronomer startled, as if suddenly awakened. "Excuse me, sir?"

"We need a port, a safe harbor, a place where we can put in, make repairs, and lay in supplies. A small planet would do quite nicely. I don't think even Mr. MacIntyre can give us the capacity to mine a gas giant, so we need a rocky world of some sort. A size somewhere between Ganymede and Mars would be ideal, although an icy asteroid would do."

Crawford blinked in astonishment. "Captain Kalfus, I suppose you used to watch Betelgeuse in Earth's night sky. Why do you think you were able to see it?"

Kalfus frowned at his tone. "Because it was so bright, of course."

"Yes, and because there is nothing in between to block it!" Crawford said. "Space is incredibly empty. The only nearby stars are M-type dwarfs, and I don't know of any with a planetary system."

Kalfus forced himself to be patient. "Professor Crawford, I know that you have not had time to study the data you

have collected on this expedition. I also know that your automated observatories took readings every time we emerged into normal space. You know what we need. Now find it for me."

The room had emptied save for Kalfus and Horner. Something about their body language made Alex reluctant to shift his attention elsewhere.

"I understand now why you made the security for this meeting so tight," Horner said.

Kalfus looked at him without speaking, waiting for him to continue.

"Rescuing the Bestials—the Genenhu—from Charon Station was not your decision," Horner said. "Alex Raymond forced your hand."

"I am not proud of that particular truth," Kalfus said coldly.

"Neither should you be ashamed of it. You knew the capacities of this starship. Your first duty was to your crew, not to former belligerents."

"This is history," Kalfus pointed out.

"Very recent history, and not beyond changing even now," Horner said. "You have just had all your section chiefs define the parameters of a problem. The problem is caused by having nearly twice as many people on this ship as it was designed to carry. Unless we make some drastic changes—changes that may not be possible—all of us could die."

"It does not take a genius to realize that tragedy can be easily averted by preemptive population thinning."

Kalfus's eyes widened. "You have an unsuspected genius for euphemism, Mr. Horner."

"I am merely stating the obvious. Probably it will occur to our people first, but soon thereafter to the Genenhu. Each group will wonder if and when the other intends to move. All will feel increasing pressure to preemptively defend themselves."

The scenario seemed all too likely, even inevitable. "Are you suggesting a final solution to our problems?"

Horner winced. "Not at all, sir. I am merely complimenting the captain on the way he imposed security on this meeting."

Kalfus stared at him for a long moment, as if searching for a hidden meaning.

"You will say nothing of this conversation to anyone. If you hear anyone voicing similar thoughts, you will report it to me. And if it's a member of our crew, you will quash such talk at once."

"As you wish, sir."

iii.

Alex strode the corridors in seven-league boots. Or, more accurately, in a ten-meter stride. He wondered why ten meters was his quantum of movement. For the moment, it was one more inexplicable fact concerning his inexplicable existence.

People were talking, arguing, laughing, pleading throughout the ship. Their combined voices were like the surf crashing on a warm beach. A woman's muffled sobbing cut through it all. Without knowing how he did it, Alex found himself in sickbay. He was looking down at a woman's back. Her shoulders heaved with uncontrollable sorrow. She stood in front of an enclosed pallet. Tubes and wires sprouted at all angles. It was impossible to see what was inside.

Two figures stood beside her. Alex recognized Dr. Youvan, head of the medical section.

"It's a gamble," he was saying. "To be honest, the odds of success are considerably less than fifty percent. We need more cold sleep capsules than we have for our crew and passengers. I do not have the resources to save everyone suffering from neutrino sickness. I have to practice triage and use my resources where they will do the most good."

"He was—*is* a hero," the woman protested. "He deserves more than to be tossed into the recycling tanks."

Her name was Michelle Frischetti, Alex remembered. She had been an as-

tronomer, like himself. She had been one of the few people on the ship to show him any kindness.

"No one knows that better than I do," the other man said. His name, Alex remembered, was Goodman Stark. Some would have said he was not a man at all, but a Bestial, human stock genetically modified to serve as slaves and survive the hardships of deep space. Features like size, strength, and retractile claws tended to frighten their unmodified human cousins. Their war of liberation had ended only a few years before.

Only his group of Genenhu, to use the socially acceptable term, had never fought in the war. They had fled beyond the Periphery of human-occupied space, getting as far as Betelgeuse before the engines of their starship failed. Alex had discovered them on a scorched cinder of a planet just before Betelgeuse became a supernova.

"This is the best we can do," Stark said. "My people have had to survive with severely restricted medical resources for the past four years. In this time we have developed biofeedback healing beyond anything known within the Periphery. The IVs provide him all the nutrients his body can use. The brain link gives him real-time control of the amount and type of nutrients and medicines. It should accelerate his healing process ten-fold."

"But the alarms when we dropped out of Space⁴," Michelle said.

"There was a power surge through the medcomp maintaining the brain link," Youvan admitted. "Mr. Nagata has not had time to run a full check, but we have confirmed that the biofeedback routines are functioning."

Michelle nodded and let them lead her away. Alex got his first unrestricted look at the enclosed bed. A hairless, emaciated figure lay within a protective plastic tube. A nozzle moved along a track, spraying skin on open sores.

Horror and shame washed over Alex. He wanted to turn away, but what was

in front of him pulled him in.

Neutrinos flood through his body, performing alchemical transmutations as deadly as they are wondrous. Cells malfunction, die, or become malignant. Weakened veins rupture. Blood leaks from every orifice. Individual systems collapse, join an accelerating cascade whose endpoint is death.

He counters by calling for continuous whole blood transfusions. Synskin is sprayed on exterior sores. Interior hemorrhaging is more of a problem. Nutrients and nanites stream in from another IV line, find healthy cells, then double and quadruple their rate of reproduction.

This becomes its own problem. Accelerated anabolism raises his temperature dangerously high. He chills the blood being transfused; lowers the air temperature of his container to near freezing.

Waste products build up too quickly to be handled by liver and kidneys, even if they were not on the verge of shutdown. He calls for a dialysis line.

Malignancies spread through his body like attacking enemies in an old Missile Command game. He shoots them down with specially modified white cells. Or he stands in a castle tower directing his knights and archers against the orcs threatening to breach the inner wall.

It is not really like either of these things, but those are the closest metaphors he will ever be able to find to describe the experience.

Eventually, a critical point is passed. He has not won the battle, but it has turned a corner. The condition of his body stabilizes. Enough has been repaired that he brings his anabolism down to its normal rate.

He senses that he is terribly weak. But he should live.

Now he becomes aware that his body is not the entire universe. He disengages his attention from himself.

And stared down at his body. He was

not dead—not yet, anyway. Youvan and Stark had hooked him into sickbay's medcomp. Like all other computers on the *Endeavor*, the medcomp was tied into the starship's network. Either Youvan had not known that or failed to realize its significance. Now some of the same programming that allowed him to direct his own medication made it possible for him to hear every conversation occurring on the entire ship. Most dealt with everyday trivialities. One or two were filled with intimacies and personal pains that he had no right to hear.

He even had a sense of smell. It took some time for him to realize that he had linked into that part of the life support system that sampled the ship's air for oxygen and carbon dioxide ratios and looked for more dangerous contaminants. Yet it was much more sensitive than that. Without thinking about it, he knew which rooms contained unmodified humans and which housed Genenhu. More—he could distinguish individuals by their sweat and hairspray, perfumes and aftershaves. He could sense which were healthy and which were very ill.

Never before had he understood the complex interrelatedness of all parts of the *Endeavor*. He reveled in input sensuousness.

Only later did he realize that these extended senses were the least of the changes he had undergone. He was thinking thoughts, solving problems that should have been impossible for him.

Either his mental processes had been greatly enhanced, or he was going insane.

iv.

The workroom adjacent to the astronomers' quarters was silent save for muttered commands at the workstations and the occasional clink of a bulb of coffee being placed on its magnetic mooring next to a viewscreen.

Michelle wearily pushed a stray strand

of hair back into her hairnet. Crawford had assigned each of them pyramidal volumes of space, the apex of all of which was the *Endeavor*. They were to comb their sectors for the sort of rocky world that could supply the materials MacIntyre needed.

There was more data than could be completely comprehended in a lifetime. Most of it had been gathered automatically while the astronomers were in cold sleep, so it was in a raw, undigested form. The first job was to screen out the irrelevant. The number of hydrogen atoms per cubic kilometer, the parallax shifts of the stars in the Perseus and Sagittarius arms could therefore be disregarded.

So what do we find? Nothing in the immediate neighborhood. Two light-years out, she found an M-class red dwarf. Four light-years beyond that were two more red dwarfs, an orange K-class, and indications that there might be anywhere from two to four brown dwarfs.

What is the likelihood that there is anything of interest in this group? Theory, confirmed by three centuries of increasingly refined observations as well as exploration, said that most red dwarfs had formed before enough heavy metals had been fused into being to make rocky worlds. Those that formed later had few if any planets, if only because their gravity wells were too shallow to retain any but the closest companions.

Therefore, any wobble induced by an invisible companion should be of a relatively short period; no longer, according to standard theory, than thirty days. This was good news, since they had a very limited set of observations.

Michelle told the computer to look for that type of wobble. In a matter of seconds, the computer returned negatives on all her candidate stars. On the brown dwarfs, there was insufficient data to tell one way or another.

Frustrated, she extended her search another ten light-years. A set of twelve new candidates appeared. She initiated

the evaluation routine on the new candidates.

There was an additional constraint on this search nobody wanted to talk about.

Chandra might maintain that her recycling system could sustain its additional burden indefinitely, but Michelle had already noted a mustiness, sometimes a sourness, in the air. Some of her friends complained about the taste of the water. Even Chandra admitted that they would have to go on short rations soon unless most of them were put in cold sleep fairly quickly.

How much time do we have? There was no definite answer to that, but as she further extended her search, with only ambiguous results, she became increasingly uneasy.

She sat back, wondering why she had been given this particular volume of space to evaluate. The angle of the apex of her special pyramid was ninety degrees. Why? The answer occurred to her almost immediately. There were four astronomers. Divide the hemisphere in front of them equally and each should get a ninety-degree slice. You looked at the space in front of you because only a suicidal fool would turn his starship around and head back into an exploding supernova.

Yielding to a perversity born of frustration, she called up the data for the half light-year between the *Endeavor* and the remains of Betelgeuse.

v.

Kalfus rubbed his chin as he studied the image floating just above eye level, "This is not quite what I had in mind."

There was a rustle of agreement around the table. Crawford seemed to be embarrassed.

"My idea," Kalfus continued, "was to get us as far way from the supernova as quickly as possible. Not to hurl ourselves back into it."

"Damn straight," somebody muttered.

"That is our ultimate goal, of course," Michelle said, trying hard not to get flus-

tered. "Our immediate goal is to take on supplies sufficient to keep us from starving to death, or from succumbing mentally to Space⁴ stresses. The superjovian system I have discovered has the resources we need and, more importantly, gives every indication of having them in accessible form."

Horner frowned. "How can you be so sure of that when your colleagues cannot say nearly as much about the much bigger red and brown dwarfs in front of us?"

"Blind luck," Michelle admitted. "As the *Endeavor* was approaching Betelgeuse, Outcast—that's the unofficial name I have given to the superjovian—passed right in front of the star. The automatics picked it up and were able to get spectra on the planet and at least three satellites. We normally would have been quite excited by the discovery, except that by then we were beginning to realize how close Betelgeuse was to detonation. All our attention was focused on the star."

Kalfus studied the written portion of her report on his tablescreen. "You say that it is six light-weeks out from Betelgeuse."

"Yes, sir."

Kalfus shook his head slowly. "Mr. MacIntyre, how long will it take the shops to fabricate the extra cold sleep capsules if we get our materials from this Outcast system?"

"Depends on the composition of the satellites and whether there are dangerous surface conditions."

"I understand that," Kalfus said patiently. "Assume a satellite with a crust of rock and ice, something like Callisto. None of Io's extensive volcanism."

MacIntyre made some calculations on his tablescreen. "Mining and then extracting the useful constituents is what takes the time. Creating the machine parts and assembling them is almost trivial by comparison. I would say . . . four weeks for the entire operation."

Horner gave a low whistle. "Cuts it a

bit close."

Kalfus turned to the head of the astronomy section. "Do you have a better candidate for me, Professor Crawford?"

"Nothing confirmed as yet, Captain. But I'm sure as we make our way back to the Periphery, we will find planetary systems at least as suitable—"

Kalfus cut him off. "I don't have time to check every star system between here and Earth. Dr. Frischetti has found us what we need. Outcast it is."

vi.

Finding suitable quarters for the Genenhu had been a problem since they had been brought on board. A few of the crew had offered space in their cabins, but most had been reluctant about sleeping in such close proximity to powerful ex-enemies. The Genenhu themselves felt out of place on the starship and preferred to stay as close together as possible. As a result, those not in hospital beds congregated in the shuttle bay. The *Bounty's* roughly cylindrical shape formed an overhang where it curved down to meet the deck. It fostered a sense of protection and intimacy, perhaps harking back to ancestral memories of caves. Genenhu families marked sections of deck as their own by dumping their meager belongings, supplemented in some cases by blankets from the ship's stores,

It was colder here than in the rest of the ship, but the Genenhu had always preferred the cold. After Charon Station, it was like paradise.

Since the bay had become a refugee haven, its lights had been dimmed in accord with the ship's day-night schedule. Peacebringer Huntsman, clan leader of the Charon Genenhu, eased himself painfully onto the deck and prepared for sleep. There was a bubbling in his lungs as he exhaled. Blood flecked his lips when he coughed. At least his fur was no longer falling out in patches.

How odd that neutrinos—ghost particles—could be so dangerous. Yet a su-

pernova produced them in such abundance that they triggered transmutations, beautiful in their way, yet toxic.

Doubly odd that this same neutrino pulse had given them the half hour warning that the supernova shock wave was churning its way out from the core of Betelgeuse, just enough time to evacuate Charon Station in the shuttle he was now camped beneath.

"Our kinfolk are concerned." His wife, Vayna, lay behind him, in a deeper darkness. "The members of this crew stop talking when one of us approach. Their stares are like knives. They speak softly, but not so softly that our ears cannot hear, that we are the cause of their discomfort, of the poor food and foul air. Even their unspoken words are loud enough to hear. *It were better were they all gone.* The meme grows hourly in strength, enlarging like a boil. Soon its logic will compel action."

"They did not have to rescue us," Huntsman said. "Their easiest course of action would have been to leave us to die. The fact that we are here evidences their good intentions."

"The fact that we are here is not due to the good will of the captain nor that of the crew." Her voice, barely louder than a whisper, seemed to come from all directions. "It was the compassion of one man, himself an outsider. Now he is a creature of wires and tubes, neither dead nor alive. He cannot aid us."

After a minute, she realized he was not going to respond. "We have three young males near testrarch. Their blood boils at insults, both real and imagined. When they see resentment and calculation in the eyes of the crew, they yearn to take action to protect us."

"Testrarch is always a trying time," Huntsman said. "They will control their wild blood and so prove themselves sapient. Or they will fail to do so and be celled."

"They are not the danger!" Vayna whispered impatiently.

Huntsman suppressed a sigh. Vayna,

never beautiful, had always been shrewd and stubborn. It was her will as much as his that kept their tiny colony on Charon Station alive when, by all rights, they should have perished. Those years had hardened both of them. Huntsman realized that they had given him a ruthlessness that he found frightening.

"My dear, have you so soon forgotten our cousin, Parry?"

"Parry?" The question took her by surprise. "N-no, of course not."

Huntsman unfolded a hand. The extended claws seemed to dance in the dimness like tiny white flames. They made dry clicking sounds as they came together.

"He was my most faithful lieutenant. Yet he attacked Alex Raymond when Raymond was our only hope of rescue. You remember the result."

"You killed him." Her voice was almost inaudible.

"I buried a knife in his neck to save us all. It was an action that saddened me, but I do not regret it."

He turned, and in less than five minutes was asleep.

Kalfus floated in a state that was not full consciousness, but was not yet sleep. It would have surprised most of his crew to learn that he was, at the core of his being, something of a romantic. He had grown up reading the tales and watching the vids of all the famous explorers. Now, even as he tried to sleep, his mind was busy trying to plan how to save his ship.

Images from the early days of space exploration rose up before him. Back then, the alternative to perfection was usually sudden death: the explosion of the Baikonur Cosmodrome, the *Apollo 1* fire, the *Challenger* explosion, and the *Columbia* incineration all happened too quickly for any corrective action by the best pilots. *Apollo 13* was pretty much the exception that proved the rule.

He plunged further back, to the days

of naval exploration. He dreamt of crusty old Bligh, set adrift in a lifeboat by mutineers, of Shackleton trying to bring twenty-seven men back from the Antarctic after his ship had been crushed by ice.

All things considered, his situation was much better than theirs. The *Endeavor* might be damaged, but at least he had his ship, and there was every reason to believe it could be fully put to rights. Neither Bligh nor Shackleton had had to face the fury of a supernova, but neither had commanded the resources of a starship.

With no sense of transition, he was standing on the bridge along with Sir Ernest Shackleton. "The supernova is not the danger," Shackleton was saying. "Damage to the *Endeavor* is not the danger. People are the danger. If my crew had quarreled or lost heart, we all would have died. Your crew and the Genenhu see each other as the problem. To succeed, you must make them see each other as the solution to their problems."

All very well, Kalfus wanted to protest, but how do I accomplish that? He tried to speak, but deeper sleep grabbed him and dragged him into oblivion:

Because he could not shut off the input from the ship's sensor system, Alex slept with his eyes open, images from various cameras mingling with his uneasy dreams. Here the captain turned in his sleep, muttering to himself. In hydroponics, Chandra looked at a new set of readings, cursed, and erased them from her screen.

In out-of-the-way sections of the starship, a few crewmembers and a small group of Genenhu met furtively and talked in low voices.

vii.

Despite the rush to break down the camp and leave, Toshiro paused to look up at Outcast as he climbed the ladder

to the airlock of the command shack. At the moment, Outcast was eclipsing Betelgeuse. With a brightness of ten thousand Suns, the star burned fiercely even at a distance of six light weeks. But if you looked up while it was completely hidden, and let your eyes adjust, you might—there! It had been a circle of darkness, detectable at all only because it made a hole in the Milky Way. Now, as he watched, a dim red line spread across the southern hemisphere. A similar, though thinner, line tried to form in the northern hemisphere. Outcast had never been massive enough for fusion. But when the clouds in the upper atmosphere parted, you could peer into the depths and see the literally red-hot remains of the superjovian's heat of formation.

The universe is breathtakingly beautiful if you take the time to notice it.

Time that had almost run out.

"Benny, I'm coming in." Toshiro pressed the button and hunched down to fit into the small airlock. The inner door opened. He unsealed his pressure suit and hung it on a wall peg. It was cold in the shack, the way Genenhu liked it. It was a wonder they had been able to survive the years on Charon.

"Am I late for lunch?"

"You are," Beneficent Hammer replied, "and you should count yourself lucky that swill Chandra is producing gets worse each day. And she doesn't provide enough of it. Not to sound ungrateful or anything, but my people were eating better before we were rescued."

Toshiro grinned, though he had to acknowledge the validity of the complaints.

Despite the expansion of the recycling tanks made possible by the raw materials they were sending back to the *Endeavor*, the quality of food seemed to have grown worse.

Disquieting rumors, which Toshiro chose to ignore, explained the situation in terms of conspiracy. Even the water

seemed to have a slightly sour smell, something Chandra vehemently denied.

Toshiro picked his way through tables filled with equipment to the small refrigerator and microwave that constituted their kitchen. He found a slice of chalky bread and smeared it with protein paste. He washed it down with a bulb of some unidentified citrus substitute.

"I found the 5603 unit in a small crater. Looks like one of the treads hit a rock at enough speed to flip it over, incidentally scraping off its antenna. That's why we couldn't get a signal from it. I wrestled it back onto its treads."

"Send it to maintenance?" Benny asked.

"No point. I just directed it to the loading dock. It will be broken down when it reaches the shops."

Benny nodded. "You will be pleased to know that we finish up by exceeding our quota for the fifteenth shift in a row," he said proudly. "That ties us with Foyle and Lockhard. We should have everything MacIntyre needs and a considerable margin to spare. Which is good because we are way behind schedule in closing down this operation."

Two weeks behind schedule, in fact. Even now, nobody knew how the original calculations could have been so far off in estimating the amount of raw materials that would be necessary to fabricate the new cold sleep capsules and expand the recycling facilities.

Without the help of the Genenhu, it was unlikely that any of them would have made quota. It was unlikely, in fact, that the mission to repair and expand the *Endeavor* could have succeeded.

To be sure, the databanks had complete specs on the rock eaters that would chew through and digest water and carbon dioxide ices as well as bedrock. And the facs machines in the shops could make anything for which they had the specs and raw materials.

The difference was that the Genenhu had done this job, even before the war and their flight to Charon. They not only

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knew how to operate rock eaters, they knew why they wouldn't perform as advertised and what the best workarounds and fixes were.

They knew the dangers of mining frozen atmospheres in temperatures of ten to twenty degrees absolute, the caverns that could open without warning beneath your treads, the ice tornadoes that could pick you up and hurl you against a cliff or into a chasm.

Toshiro found it impossible to understand why this was not as obvious to everyone as it was to him. But when he had mentioned it in the *Endeavor's* galley, he had provoked derision and hostility. One of his crewmates had approached him threateningly. "Don't tell me that we couldn't succeed without the Bestials. Without the Bestials, we wouldn't *have* to do anything."

Those resentments, he expected, should have evaporated by now. Nothing erases ill-feelings like success, and though it had taken longer than scheduled (much longer, he admitted to himself), they now had succeeded in every respect.

"There's the signal," Benny announced, looking up from the communications panel. "Time to close up shop. Let's move."

With little regret, Toshiro shoved the remains of his lunch into the recycler port by the side of his table. Spider robots were already pushing everything not screwed down into similar ports. He shrugged himself back into his pressure suit, wrinkling his nose at a smell he had not noticed earlier, and led the way back outside to the surface of Dantes. Rock eaters were already in position facing the shack.

"Request disassembly permission." The metallic overtones identified the speaker as an AI.

"Granted," Toshiro said.

The nearest rock eater took a bite out of one of the supports. The shack sagged slowly toward the surface. It came within reach of the other rock

eater, which crunched the side of the shack, swallowing the air lock. Soon the shack would be reduced to raw materials, which would be shipped up to the *Endeavor* and stored as supplies for the shops.

Benny had already seated himself in the pilot's chair of the Flying Carpet, a rectangular rocket sled that was the chief mode of transportation on Dantes. As soon as Toshiro was strapped in behind him, Benny gave the lift-off command. There was a barely perceptible puff of acceleration. They soared in a graceful arc over the disconcertingly near horizon and settled down, with a stronger spurt from the engines, next to the *Bounty*. Rock eaters disgorged their storage bays into the ship's hold. Workers like themselves were lining up to be taken back the *Endeavor*. In their pressure suits, it was impossible to tell crew from Genenhu.

Which, Toshiro thought, is just the way it should be.

viii.

Horner stared impatiently at the holosphere. Ovoid shapes covered with fine hairs darted through the air on apparently random paths. One, at the edge of the holosphere, was in the process of dividing itself in two.

"I don't have time for biology lessons," Horner said. In fact, he disliked biology. It had always seemed to him to be compounded of equal parts messiness and pain.

"In case you have forgotten, we have a deadline only a few hours away. I wouldn't be here at all if you hadn't claimed you had evidence of sabotage."

"There it is," Chandra said, jabbing her finger at the holosphere. "That is what has nearly destroyed my recycling facility. Those microbes have been devouring the cleansing bacteria which, in stage one, remove all toxic materials from the raw waste and in stage two form the basis for our artificial food chain."

Horner looked at the holosphere with new respect. "Since you have identified the culprit, I suppose you have been able to implement countermeasures."

"Of course," Chandra said dismissively. "All invaders have been purged from the system. The important thing is where they come from. These are from the Bestials' body flora. The Bestials contaminated my system in attempt to kill all of us. You and Kalfus had better do something about it before they try again."

Youngblood More had been feeling increasingly odd ever since being rescued from Charon. Hot flashes. Difficulty sleeping. Spurts of anger followed by periods of almost suicidal depression, neither of which had an objective cause.

Aunt Stelare, who had taken him in after his parents died, blamed the change in diet. The food in the *Endeavor's* galleys might not have that much taste, but it was more nourishing than anything he had eaten for five years. He just needed time to adjust to it.

She would have been more convincing if he had not seen the fright in her eyes.

Being by himself had been good. The work on Dantes had been important to everyone; the dangerous environment had given him focus. Any surrender to unreasoning emotion would have been immediately fatal. Mortal fear served to concentrate the mind wonderfully.

Now back on the *Endeavor*, all he wanted to do was find a few friends, hoist a few drinks made from their own still, and go to bed. On his way to the galley, he passed an incompletely closed door.

"The Bestials contaminated my system in attempt to kill all of us. You and Kalfus had better do something..."

Rage was like an explosion within him. For an instant he crouched, ready to spring into the room and destroy his enemies. He restrained himself with the last shreds of reason and thumbed on

his wrist communicator.

Horner shook his head. "I get the first two points. These microbes, whatever they are, were playing havoc with the recyclers. They entered the ship with the Genenhu. And bacteria can find new niches for themselves and even jump between species sometimes. I know that much from keeping up with the news shows.

"What I don't get is why you think this is intentional. What makes this sabotage?"

"I don't see how this could be more obvious," Chandra said incredulously. "The problem comes in with the Bestials. A war with the Bestials has just ended."

"As you say, it has ended. And this group fled the war at its beginning."

"That's what they say," Chandra said disdainfully. "Of course, when Raymond discovered their distress signal, Betelgeuse was on the verge of explosion. They would have said anything to be rescued."

"Good point," Horner conceded. "Now tell me why they would sabotage a food system just as important to them as it is to us?"

Chandra opened and closed her mouth twice before she could speak. "Bestial metabolisms are known to be more robust than those of standard humans," she said finally. "They must have been trying to weaken us until they could stage a coup. Then they would fix the system."

"An interesting theory. Don't mention it to anyone but me or the captain." Horner turned to leave.

"Don't dismiss what I am telling you. I thought you were the sensible one," Chandra called after him.

"I am. That is why I am not just putting you in solitary immediately."

"Tell me again," Vayna said, "and try to be coherent this time."

A crowd of Genenhu was gathering.

Some had seen Youngblood rush into the *Bounty's* bay. Others had heard something of Youngblood's story and had told their neighbors. Vayna wanted all of them to hear all of it.

Youngblood took a deep breath and exhaled slowly. He took his time, reciting one of the Twelve Mantras of Sanity, and began again.

"I was coming here by way of the recycling facility. The door to that section had not closed all the way. Chandra was talking to somebody. I think it was First Officer Horner. He was saying that we had sabotaged recycling as a first step in taking over the ship. They decided to do something to take care of us."

Vayna said nothing, letting his words have their full effect on their audience.

"Horner's always disliked us," someone said.

"Can we trust this story?" someone else asked. "The boy's clearly in *testrarch*."

Youngblood turned to the speaker with claws extended, restraining himself with a visible effort. "I heard what I heard!"

"Where's Huntsman? He should hear this."

"My husband is not available," Vayna said. *Thank God*. "He is with Captain Kalfus. If Youngblood is correct, he may already be a hostage or dead. We must act now."

"Neutrino pulse . . . now." A gentle chime sounded on the bridge. Kalfus looked—unobtrusively, he hoped—over at Peacebringer Huntsman. This same pulse had nearly killed Huntsman and the other Genenhu more than a month before. It was the reason Alex Raymond was still on life support. Then, they had been forty light minutes from Betelgeuse. At this distance of six light weeks, the neutrinos were harmless. Still, Kalfus had to admire the way Huntsman refused to flinch.

"You don't leave much of a margin," Huntsman said.

"I wanted to make sure we had everything we need," Kalfus said. "I don't intend making any further stops until we are within the Periphery."

Huntsman nodded. His presence on the bridge was ceremonial and, in fact, there was little enough room for him. In the vids, starship bridges were always wide and spacious with ceilings three stories high. But space is always at a premium in any kind of starcraft. There is exactly the volume required and not a cubic meter more.

Still, it was important for him to be here. Kalfus had been making a show of consulting with him and complying as completely as possible with any wishes expressed by the Genenhu. The purpose was to reinforce Huntsman's authority in hopes that he would be able to control the malcontents and hotheads among his people. It seemed to be working so far.

Blood rushed to his head as the impulse engines cut off. They coasted in free fall.

"Navigation."

"The vector is locked in," Alicia Vallejo said. "Navigation is green."

"Engineering."

"Quantum drives at full charge," Fu reported. "Engineering is a go."

"On my count," Kalfus said. "Five, four—"

All the lights went out.

Goodman Stark ran along behind the first assault group, uncertain what he would do when they ran into crew members. Eighteen hour days in sickbay had isolated him from the rest of the ship. Certainly Dr. Youvan would never be part of any plot against the Genenhu. He wished he could be as sure about the other members of the crew.

A transport capsule opened at the end of the corridor and a man stepped out.

Youngblood bounded into the air and slammed him into a wall.

"What are you doing down here?" Youngblood's voice was half growl. His

fur was on end, making him look half again as large as he actually was.

For a few seconds, his victim was too stunned to reply. Then he mumbled something like, "Getting the crap beat out of me, I guess."

That's Toshiro, Stark thought. He pushed his way closer to his friend, wondering if he could keep Youngblood from beating him to death.

"Are you here to spy on us?" Youngblood demanded. "Or did you come to attack us?"

Toshiro was still too dazed to be as frightened as he should have been. "Attack, of course. Just me, without any weapons, against . . . all of you. Seems fair."

Several of the Genenhu chuckled. Not only did Youngblood's accusation appear ludicrous, but several of them had now recognized Toshiro, who had gone out of his way to befriend many of them. Stark felt the tension beginning to ease.

Youngblood snarled at them and turned back to his captive. "Answer the question!"

Toshiro had recovered enough to focus on his assailant. "We were getting some anomalous sensor readings from the electrical system," he said, speaking carefully with a bleeding lip. "Mac sent me down to check things out."

Stark stepped forward. "I know this man," he said, putting a hand on Youngblood's shoulder. "So does Benny. He's—"

"Hey, what the hell's going on down there?"

It was not a wide corridor. Through the press of bodies, Stark could make out two, maybe three, approaching crewmembers. They held what appeared to be stunners.

Things happened very quickly. Someone threw a knife. It caught one of the crew in the shoulder, knocking him backward and twisting him around in the air. Red droplets spiraled out from the embedded blade. His companions pressed against the walls and aimed

their weapons.

Darkness swept over them. There was a muffled popping sound. A sudden wind jumbled them against each other as it carried them down the corridor. Toward the hull. Stark gasped, trying to inhale increasingly thin air.

They've blown the locks, Stark thought. *We're all going to—*

Think of a child learning to walk. He struggles upright, staggers, and falls. He tries again. This time as he weaves he grabs a lamp for support. It topples, smashing into a glass cabinet, shattering the delicate antiques contained within.

The child lurches back, frightened by the noise and the falling shards of glass. It takes much practice for all the muscles in legs and torso to cooperate just so.

"We had a temporary depressurization in the Level 10 X cross corridor," MacIntyre reported. "I don't know the cause, but the safeties seem to have taken care of it."

"Any casualties?" Kalfus asked.

"None in the shops, but I don't have any direct reports from 10 X."

"I am sending Mr. Horner down to assemble a peace-keeping squad. Grant him every assistance." Kalfus turned his attention to the other half of the split screen. "Mr. Fu, what progress?"

Fu's eyes showed a disconcerting amount of white. "Very little, Captain. All readings are well within the green zone. The quantum drive has more than enough power to jump us up the ladder. It is as if something is blocking the final command."

"Mr. Fu, I know it would be disturbing for me to give you a nova countdown, so I will forego that. You know as well as I how little time remains to us. You have my authority to commandeer any resources you deem necessary."

"Yes, sir."

Fu signed off. It was suddenly silent.

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Less than an hour before, the bridge had been overcrowded. Now it was nearly deserted. Vallejo was still at the navigation console, but everyone else was gone. Horner and Huntsman had left to restrain the more pugnacious of their respective peoples. Most of the rest of the crew was frantically trying to find a broken connection, a corrupted line of code, or whatever else might be keeping them from jumping past light speed.

This is stupid, Kalfus thought. It is in nobody's interest for us all to die here. It added poignancy to a growing feeling of desperation. Had Huntsman turned traitor, overpowered him, and shoved him out an airlock, there would have been a small part of his mind that would have nodded approvingly. There are always enemies, and one fails to identify them at one's peril. They will act in their perceived best interests, which will probably not be yours, but that is just the way things are.

This was not like that at all. The worst of it was that there was nothing more he could do. He had given the appropriate orders and his people were trying their best to carry them out. All he could do now was to wait and wonder which of his prior decisions had been the fatal one.

Should I have refused to let the Genenhu on board, left them and Raymond and even the *Bounty* if necessary to be vaporized? Shameful as it was to admit it even to himself, that had been his first inclination. Yet in retrospect he could only be grateful that Raymond had forced him to save the Charon colony. Huntsman and Stark and many of the others were good people. Whatever mistakes he may have made with them, the decision to save them had been right.

Should we have left sooner? Ah, that was a harder one to answer. Flawed code had been responsible for work schedules causing them to do far more mining than was necessary for the number of cold sleep capsules they needed.

The source of the flaw had never been satisfactorily explained.

He had admitted to Peacebringer that he wanted to have all the provisions they would need for the entire voyage back to the Periphery. Want is not the same as need. There would have been other opportunities to restock along their 600-plus light year path. If he had done that, there would almost certainly have been time to fix whatever glitch was holding them immobilized before the supernova wave-front hit them.

The *Columbia* crew had at most scant seconds to realize their doom. The *Challenger* astronauts might have survived all the way to surface impact. But it was not the astronauts, nor Shackleton watching the *Endurance* sink beneath the ice, nor even his hero, Cook, facing the spears, who seemed to speak to him now. It was Scott on his way back from the South Pole, knowing that he and those who had depended on him would die because he had not provided sufficient leadership and intelligence.

No one had reported back in—how long? “Mr. Horner, report.” Nothing. “Mr. Fu, Mr. MacIntyre.” Static. It was as if everyone on the starship had been swallowed by the void.

“Captain Kalfus.” The voice on the intercom startled him. “Please report to your cold sleep capsule.”

Kalfus stared at the intercom, trying to place the voice. “I can’t do that just now,” he said carefully. “I am trying to keep us from being incinerated by a supernova.”

“I have taken care of that,” the voice assured him. “Look.”

The aft viewscreen came to life. Outcast was a circle of darkness surrounded by a red halo. A digital clock in the right corner displayed two rows of digits. Then one row.

The halo brightened, swept outward to swallow the stars with a painful incandescence as it reached toward the *Endeavor*—

The ship seemed to lurch. Outcast,

Betelgeuse, the entire universe vanished. A roiling fractal static replaced it on the view screen. Heat flashed over Kalfus as the starship punched its way up to Space⁴. Suppressor fields filled the bridge with an almost subliminal hum.

"There. You can now report to your cold sleep capsule."

"Identify yourself," Kalfus commanded, "and tell me why I can't contact any of my crew." If the Genenhu had mutinied and wanted to demonstrate their command of the ship, they could not have found a more impressive way.

"Save for yourself and your navigator, they are all already in cold sleep," the voice answered. "I am Alex Raymond."

Alicia Vallejo looked over from her station with wide, frightened eyes. Kalfus hoped he did not look as frightened as he felt. Nobody believed haunted spaceship stories. Still . . .

"Don't trifle with me." He was pleased to note the steadiness of his voice. If there was any quaver, it was caused by anger. "Alex Raymond is on life support. And I don't believe my crew would desert their posts."

"They did not desert their posts. Some compulsion was required."

It was what Kalfus had expected to hear, but no less terrible for that. "Are they . . .?"

"Their capsule sensors display optimal readings. There may be a few bruises when they awaken, perhaps even a case or two of neural feedback. Nothing more."

Manhandled into the capsules with the occasional aid of stunners. Even completely healthy, Raymond could never have overpowered all crew and Genenhu.

"We need a conscious shift crew," Kalfus said. "We are a necessary check for computer errors induced by quantum stresses. Especially on a flight of this duration."

"If you try to maintain a shift crew conscious, they will all die."

Kalfus nodded, trying to evaluate the

inferred threat. "Why?"

"The recycling system is just about to collapse. Chandra located microbes brought on board by the Genenhu that have infected the system."

"She told me about that," Kalfus said.

"She thought she purged the system with specifically tailored antibiotics. Unfortunately, a few survived, however. The new effect was that she managed to breed super microbes, immune to her antibiotics."

"Others can be developed."

"She tried. Nothing worked. I have access to her encrypted notes. Everything she came up with to destroy the invaders killed the recycling bacteria as well. She did not want to inform you until she had a solution."

It sounded all too like Chandra. "If that is so, how are we to get home?"

"I will fly the ship," Alex answered.

"The sickbay systems which sustain me run independently of Chandra's recycling. The biofeedback circuits were somehow linked to the ship's command and control systems. I have access to all sensors, every database, each operating system, as well as the tutorials on each."

"In a way, you can say that I am the *Endeavor*."

Kalfus licked his lips, for a moment too stunned to speak. "You caused the power blackout," he accused. "And the airlock breach."

"I was still learning how to control the relevant operating systems," Alex said. "And I had to stop the fighting before somebody got killed." He sounded anxious and a bit defensive.

"Raymond, you must listen to me," Kalfus said. "I meant what I said earlier. Quantum space stresses man and machine alike. Flaws are introduced into both. Redundancy is the only way to weed them out. The members of a crew keep each other sane and correct the mutations in computer code before they reach a critical mass."

"You will be by yourself for more than two and a half years. You will have no

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way of checking your own perceptions or thought processes. The isolation by itself would try the sanity of a man even without quantum stresses." *If you haven't already gone over the edge.*

There was a pause in which he might have heard something like a sigh. "Yes," Alex said softly, "but it must be done."

Something rustled behind Kalfus. He turned and saw one of the starfish repair robot drifting out into the bridge. Tentacles extended to either side of the corridor from which it was emerging held it steady against the gentle draft from the ventilators. One of the remaining tentacles held a stunner. It raised the weapon to eye level and fired.

ix.

"Radar contact," Thunderfist called out.

Wiseye nodded, trusting that in the cramped quarters of their miner, Thunderfist would see the gesture in his peripheral vision.

Their target had forced itself on the attention of the Free Fighter and Live Lion clans with its Cerenkov wake as it fell into normal space. Appearing unexpectedly near the heliopause boundary of this K-type star, it had reminded some of the old-timers of the raids of the War for Liberation. A few minutes later, they picked up the automated distress call. Being closest, the crew of *Draw Three* was obliged by law and custom to render aid.

Besides, working this unnamed star's pitiful excuse for an Oort cloud had them barely breaking even. Salvage would be much more profitable.

Thinking of salvage, Wiseye thumbed on the recorder to document any claim they might make and serve as evidence, for the suspicious, that they had not spaced any survivors.

"To think that just a few years ago, we were all rebels and buccaneers. Now we've become lawyers," she muttered.

"How's that?" Snowfox asked.

"Just muttering to myself," Wiseye

told her nephew. Then, to forestall Thunderfist: "Old people do that sometimes."

Thunderfist laughed.

It was becoming increasingly likely that they would indeed get some sort of salvage out of this exercise. For the past three hours, they had sent out hailing signals as they closed with the target. There had been no response.

"Hey, that thing's big!" Snowfox said. "Could it be a battlestar?"

I hope to hell not, Wiseye thought, remembering the destructive capabilities of those planetoid-sized weapons platforms.

Thunderfist pulled the readings onto his screen and accessed the database. "It's almost big enough, but it doesn't match anything in *Jane's*."

Something tugged at Wiseye's memory, something she had seen in a news video years before. "That is because it's an exploration vessel, not a dreadnought. It's the *Endeavor*. It was supposed to explore as far out as Betelgeuse. It was launched from Earth orbit."

Snowfox asked the obvious: "So what's it doing out here?"

"No idea. Send a message to Live Lion that there is enough salvage here for the entire clan."

As they drew nearer, they saw that the starship had a slow tumble. "That complicates matters," Wiseye said. The surface was smooth. There would be nothing to hold onto.

"Okay," Wiseye said. "Here's the plan. There is an exterior hatch a third of the way from the small end. Ship's computer can manipulate the thrusters so that we maintain a constant distance from the hatch. Thunderfist, you will fire a line with a sticky pad at the hatch and haul yourself over. You will have to fight some centrifugal force, but it shouldn't be more than point two gees. You will then attempt to enter the airlock."

"We can blast or cut our way in if we have to," Snowfox said. "*Draw Three*

has the stuff."

"We don't want to do that," Wiseye said. "There still may be someone alive in there."

"So we will have to anchor an inflatable lock to the hull to avoid depressurization," Thunderfist said. "Making this even more of a pain in the ass than it already is."

The first part went according to plan. Thunderfist fired the line from his console, dogged shut his helmet, and went outside. Snowfox focused a spotlight on his destination. This far out, the starship drifted in perpetual dusk. Thunderfist reached the line, attached the traveler already on his left wrist to the line, and let it pull him "up" to the *Endeavor*.

"Any problems?" Wiseye asked.

"Don't look at the stars while in transit," Thunderfist said tersely. Then: "Aw, shit."

"Thunderfist?"

"Spread the spotlight along the hull to my left. Take a good look through the cameras and tell me what you see."

Fractal snowflakes wrapped around the hull like arms of an interstellar kraken.

On the viewscreen, Thunderfist reached a hand over to touch the pattern. His glove seemed to disappear beneath a layer of dust, which began a slow, spiraling fall toward the *Draw Three*.

"What...?" Snowfox asked

"Quantum stress," Wiseye said. "I've never seen a hull so riddled with it. That ship should have disintegrated a long time ago."

"If the sticky pad had anchored on that—" Snowfox said, with sudden surmise.

"Thunderfist would have had an interesting time of it." There was no point in saying anything more.

Wiseye snapped her own helmet shut and prepared to go over. Snowfox predictably objected to being left behind.

"You need to respond to any messages from Live Lion as the other ships

come in. And if there are any problems over there, Thunderfist and I may have to make for the nearest exit. Then you will have to chase us down and pick us up. Enjoy your stint as captain."

It was disconcerting, if not physically difficult, to climb up the side of *Draw Three*, attach a traveler, and let it pull her over to the *Endeavor*. Thunderfist had been right: it was better not to look at the stars swinging about her.

He was waiting for her on the other side of the airlock. His helmet was already off. "Pressure is just slightly below standard, ditto the oxygen content. All the other readings say it's breathable. Smells funny, though."

They found the source of the smell soon enough. The hydroponics section had been infected with some sort of rot. What had been long corridors of wheat were now barely recognizable pools of slime. The stench made Wiseye gag. They backed out quickly.

"That should have been generating a substantial portion of the oxygen for this ship," Thunderfist said. "If we still have oxygen even though all the plants have died, we must be the only ones breathing it."

The engine room had an acrid smell. Burn marks on the walls evidenced electrical arcing. Certain units were charred beyond recognition.

The fractional gravity had allowed them to proceed by jumping along the walls, using doorways and exposed pipes as handholds. They crossed a spin axis and suddenly everything before them was down a steep slope. Wiseye reminded the sometimes-impetuous Thunderfist that they could still break an ankle or damage a pressure suit if they fell too far.

Before they reached the cold sleep bay, they came across cubicles crowding the corridors. They had obviously been constructed after the ship had been launched. Even more surprising was the fact that many of them contained Genenhu. The *Endeavor*, Wiseye

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remembered, had been crewed by basic stock humans. Its mission had in part been a political statement, a declaration that the Periphery and the stars beyond it did not belong exclusively to Genenhu.

As far as they could tell from the readouts on the sides of the cubicles, all the occupants appeared to be in good health and ready for resuscitation.

There was one patient in sickbay lying in a transparent container. Skin stretched tightly over micro gravity atrophied muscles. Slime of some sort covered a wire mesh helmet. Several IV tubes, meant to provide nourishment or medicine, were blocked with a black gunk.

Thunderfist shook his head. "Poor guy must be—" He cursed as the eyes opened and focused on him.

"He's alive!"

Wiseye had been studying the monitor with increasing alarm. "Not for long, unless we can get him out of there."

X.

Waking and dreaming have long since run together and become indistinguishable. He remembers learning to navigate in the higher quantum spaces, testing himself with a series of small jumps, yet always pressed by the exploding star behind him. At some point, he must have become overconfident. There had been a jump lasting as long as ten days. When the ship fell back into normal space, several lines of crucial code were corrupted. He could not activate and control the starfish. That was when he learned that the code correction function itself had been corrupted; on that jump or one earlier.

From then on, whatever broke stayed broken. It was an inexorable nightmare.

Lights failed and could not be replaced. The recycling system collapsed completely. An IV line became infiltrated; the fluid going into his tissues in-

stead of the vein. He felt himself weakening. There were times when he thought clearly enough to realize how confused he was other times.

One more jump. Do the calculations. Ignore the systems in the red zone. There should be just enough operational power. This is the only alternative to drifting in the outer darkness forever.

Jump. He remembers a detonation and frantic attempts to quench the resulting fire. And then a growing dimness, until . . .

"Can you hear me? Do you understand what I am saying? I am Wiseye of Live Lion clan."

A Genenhu. One he does not know. He has enough peripheral vision to recognize that he is not in Endeavor's sickbay.

"Abb thub." His lips stick together, his tongue feels swollen. Someone presses a sponge to his mouth. Small ice chips are provided. He sucks on them, taking his time.

He feels weak, so very weak.

"Are the others okay?"

Wiseye nods. She seems in the grip of some profound emotion.

"All the cold sleep capsules read green. We will begin resuscitation as soon as the rest of our clan arrives.

"You are back in the Periphery. Your entire crew has survived."

He smiles, closing his eyes. Finally, he can give himself a hero's reward, a deep and dreamless sleep. ■

(EDITOR'S NOTE: The crew of the Endeavor was last seen in "Transit of Betelgeuse" [May, 1990].)

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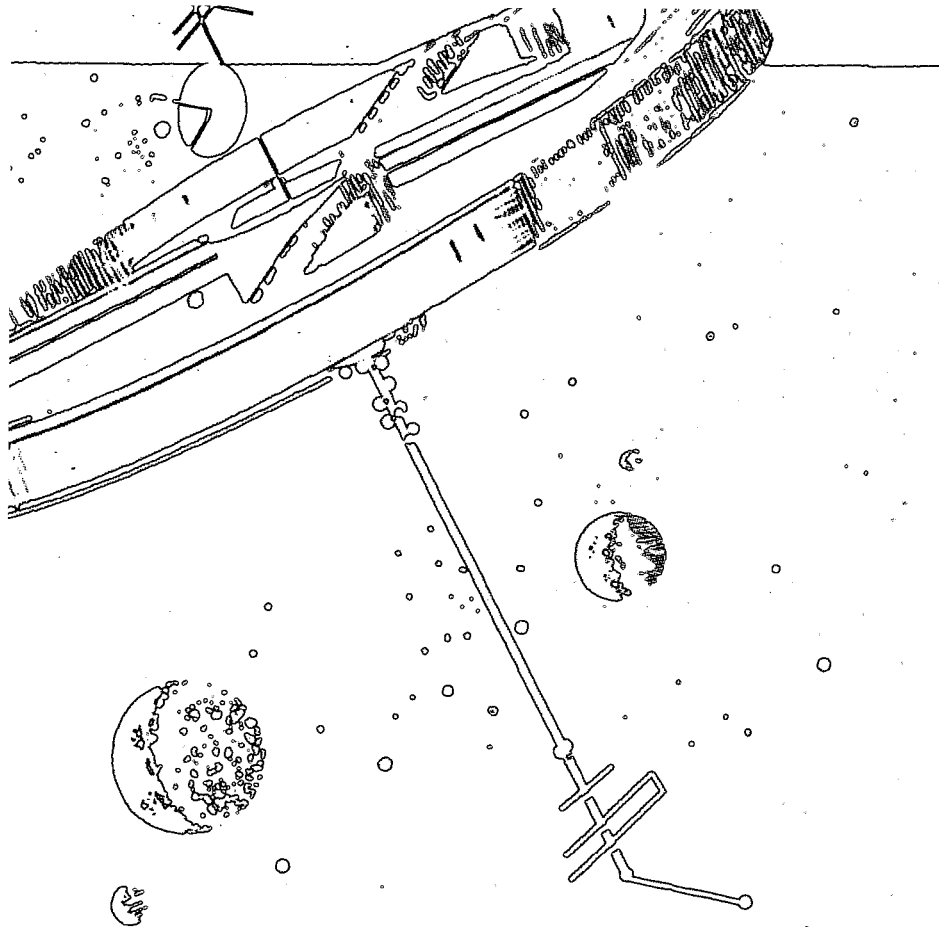
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How do you hide a message so that only those you want will get it? An old question, but in this case it had an added twist. . . .



The Keeper's Riddle

Joe Schembrie

Illustration by Vincent DiFate

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Holding a cup of tea, Joshua Wang leaned against the veranda rail of the security complex and basked in the processed sunlight of the artificial world known as Avalon.

"Well," he said. "Cracking an egg—I guess you call them 'asteries'—is always a puzzle. But for me, the bigger mystery is, why do you want this one cracked?"

Parrots glided amid the rainforest that sloped below. Sailboats lazily skated the waterway that curled into vertical walls that joined into an arch far overhead. Directly above, and upside down from Joshua's perspective, a monorail gleamed between the hamlets dotting the lushly-vegetated interior of the miles-in-diameter cylinder.

"It's your livelihood, isn't it?" Nigel Thornby replied. "Salvaging abandoned ships and facilities? I thought we were being of service."

Joshua drained his tea and laid the cup atop the roboSERVER. Then he met the eyes of Avalon's director of security.

"I appreciate the information. So what's in it for you?"

"Don't worry about us." Thornby waved at the villas on the other side of the customized fjord. "We've enough money."

"I've learned that Belters are always tight with resources. Frontier ethics and all. So forgive me, but what's in it for you?"

"We have no experience investigating abandoned facilities."

"You're not answering my question."

"Well, it's not responding to hails. It's technically a derelict."

"I have to know, or I can't do it."

Thornby glared. "All right. Come inside."

They entered the office. Thornby brushed Joshua from the computer. "Mind? I have to enter the system password."

Joshua moved away. Thornby tapped the keyboard. Room windows opaqued. A wall screen displayed orbital trajectories: Avalon and her sister "asteries" in

formation, with a single object labeled "509" crossing their path.

"As discussed, Object 509 is your destination," Thornby said. "Now let's project orbits back in time a few years."

His keyboard chattered, and the view zoomed to encompass the entire Mars-Jupiter asteroid belt. Objects—natural asteroids and artificial worldlets—were color-coded for affiliation: Avalon Commonwealth, Nova America Federation, Trans-Aryan Alliance, and countless more. The date and time counter spun backwards, and the orbits ran clockwise. Then they froze.

Thornby moused a pointer toward the time-altered position of Object 509. It was far from the Avalon Cluster—but within a mere million kilometers of a Trans-Aryan grouping.

"It was once part of the Trans-Aryan Alliance," Joshua observed.

"Yes. Seven years ago."

"We've never salvaged anything from the Trans-Aryan Alliance."

"Of course not. They don't abandon, they claim—and conquer."

Joshua detected harshness in the tone.

"Well," Joshua said slowly, "I'm no friend of the Trans-Aryan Alliance."

Thornby snapped off the screen. "As a private contractor salvaging an object legally derelict, you can investigate without creating an interplanetary fuss. And we'll gladly pay premium for anything found."

"Salvagewise, or military intelligence?"

"The Avalon Supreme Council won't let me officially pay for intel—but if you *share* intel with us, don't be surprised if we bid, say, fifty kilos platinum for a bag of doorknobs."

"I'll look for doorknobs. Now, you're sure it's derelict? Not responding at all?"

Thornby hesitated. "Well, the Keeper's babbling gibberish."

The security chief opened a folder and shoved across a single sheet of paper inscribed with a few terse lines of

block letters.

"*A child shall lead, a child must read ... Once in life and twice in resurrection. ...*" Joshua skimmed the rest. He slowly raised his eyes. "Curiouser and curiouser."

"Cracking this egg will definitely be a puzzle," Thornby replied. "Or rather—given that it's in words—a riddle."

Joshua met the other members of his crew, Ann Striker and Lucas Chulaski, at the municipal space dock. They chartered an autopiloted shuttle together. The shuttle dropped from Avalon's spinning rim and weightlessness reigned. The thrusters fired an impulse of a few seconds and they coasted in vacuum, away from the asterie on a hundred-kilometer journey to the relative point in free space where they had parked their ship.

Joshua silently contemplated the stars encompassing the shuttle. Lucas massaged his stomach, swollen from one meal too many at the upscale restaurants that crowded the colonnades of the island-world's malls. Ann kept looking back at the green hills and sparkling waters revolving beneath Avalon's translucent roof.

"Reena would love living there," she said. "I wish we could afford it."

A brightly patterned shirt in a children's size floated from the shopping bag in her lap. Joshua caught and returned it.

"Maybe after this job," he said.

Lucas's eyes slitted, but he said nothing.

Outside the shuttle, a fifty-meter diameter pincushion neared. Joshua's phone chirped. Hermes hailed: "Ahoy, mates! This is the good ship *Raven* calling. Today's magic words, please!"

"Sunshine Odyssey Magenta," Joshua said.

"No, I'm sorry ... oh, did you say, 'Sunshine Odyssey Magenta?' Why, that's right! Come on in!"

Joshua gave Lucas a headshake.

"You're programming Hermes to be cute now, I gather."

Lucas grinned. "He still doesn't get my jokes."

They boarded and the shuttle automatically departed. Then it was briefing time.

"*Trans-Aryan Alliance!*" Lucas exclaimed. "You don't mess with them! They're worse than Earth!"

"Josh, you're sure it's not booby-trapped?" Ann asked.

"Course it is," Lucas said. "Why else send us?"

"I didn't like Thornby," Joshua replied. "But I trust him on the money."

Joshua told them about the door-knobs. They voted. It was unanimous.

Lucas expanded the propulsion-drive's magneto-plasma bubble. Ann checked the environmental systems. Joshua plugged the course into Hermes. And then they were under way.

Days and megakilometers passed as they coursed through the asteroid belt, avoiding as best they could the ever-shifting spheres of sovereignty claimed by the thousands of miniature worlds built and populated by the teeming masses who had migrated from Earth in the previous decades of the Interplanetary Diaspora.

Hermes navigated and tracked the rare meteoroid that came under the purview of his radar sweeps. Ann sent and received videos with her daughter, and played her piano keyboard. Lucas continued stamping his personality onto the ship's AIs. Joshua pattered and brooded.

Object 509 swelled in the telescope. It was another of the belt's ubiquitous revolving inhabited doughnuts, but a thin one: one kilometer radius, fifty meters wide.

"Precession of twenty five point six degrees," Hermes reported.

"Ouch," Lucas said. "Is their Keeper even on-line?"

At Joshua's request, Hermes conduct-

ANALOG

ed an Asternet-wide query of available historical databases. Lucas summarized: "The Trans-Aryans purchased eggs of this type back in the '40s. Usage was classified, but was suspected to be military-biological research."

"I'll prepare the biohazard gear and med packs," Ann said.

"Josh," Lucas said. "Everyone accuses the Trans-Aryans of spreading designer-plagues around the belt. If there's proof, they'd kill to keep it secret."

But they all voted to keep going.

Raven continued milligee deceleration for two more days, halting at a thousand kilometers from Object 509.

No marker lights gleamed. The wheel spun with a slow wobble. The roof glass was tinted, hiding the interior.

The non-rotating central node, held in place by four crosswise spokes, protruded a grape-bunch of house-sized turrets.

"Heavy laser cannon," Lucas said. "Joy!"

"Receiving beacon signal," Hermes reported. "ASCII format. Repetitive."

"On screen," Joshua said. Nothing happened, and then he remembered to be more specific: "Put the beacon signal message on the screen."

The three human crewmembers clustered around the comm-station monitor. Block letters scrolled:

A CHILD SHALL LEAD,
A CHILD MUST READ.
ONCE IN LIFE AND
TWICE IN RESURRECTION.
IN WIND AND IN FIRE,
THE BEGINNING AND
END OF STARS.
WHEN IT LEAVES TIME.
IN WORDS BUT NOT WISDOM.
WE ENTER.

"Very lyrical," Ann said. "What does it mean?"

"That their Keeper's gone Turing!" Lucas snorted.

Joshua unfolded the paper that Thornby had given him.

"It means," he said, "that we're going in."

First they sent Hermes Junior.

It took hours for the heavily-shielded probe to cross the distance from the ship to the station (which was what they called Object 509 now). The station issued no warnings, the cannons did not fire, the probe did not vaporize.

At one-kilometer range, the probe's multi-spectrum cameras swept the contours of the station—and zoomed on the stealth flaps.

"They could have stayed hidden from Avalon's long-range radar," Lucas said. "Wonder why they didn't."

Ann pointed to a dark spot. "Garage port."

Joshua nodded. "Okay, Junior. See that hole? Check it out."

"Right-oh," the probe replied.

Thrusters firing, Hermes Junior imitated the station rim's spin rate and arc, and alighted on the lip of the four-meter-wide garage entrance. The probe sprouted legs and the thrusters stopped.

Junior crawled inside the garage. Immediately the camera view blanked. After mere seconds, though, the probe returned, facing out the port at revolving stars.

"I lost commlink," Junior said needlessly. "Want me to investigate in auto-command mode?"

"Yes," Joshua replied. "Report back in five minutes."

"Report in five, gotcha."

The screen went blank once more and the human crew fidgeted. In five minutes, Hermes Junior returned, and relayed a recording of its journey: into the garage, past a parked shuttle, down a winding passage, to an airlock door with an alphanumeric keypad at its side.

The monochrome video screen above the keypad bore the now-familiar lines: A CHILD SHALL LEAD, A CHILD MUST READ . . . and all the rest. The

probe's travelogue concluded with the sticking of an electronic finger into the data jack beneath the keypad.

"I interrogated the Keeper to request entry as per standard procedure," Junior said. "It required a password with an input field of eight bytes. Do you have the password?"

"No," Joshua replied. "Place yourself in standby."

He turned to the other humans. Both were staring at the screen. Lucas was frowning and scratching his beard. Ann reached for the paper Joshua still held.

"Could these words be a set of clues for the password?" Ann asked.

"*Once in life and twice in resurrection,*," Lucas quoted. "*In wind and in fire. The beginning and end of stars?*" How does all that apply to a single word?"

"A song title, perhaps. We should do an Asternet search."

"I've done one already," Joshua said. "Dozens of them. Nothing comes up."

They were silent for a moment.

"Okay," Ann said. "Could be a theological term, or literary allusion, or two words conjoined—like, uh, 'starwind' or ... I don't know. Something."

"Hermes could interrogate with a list of English words and conjunctions," Lucas said. "Then we could try foreign words and—"

"Lucas," Joshua said. "Keepers usually force a delay of several seconds between password inputs. It'll take years to run through all the possible combinations."

"Well, Josh, how many eight-letter words and conjunctions in English are there?"

"*Lucas*," Joshua said. "We don't have time for guessing games."

Growling, Lucas crumpled his face and hunched his shoulders like an angry troll, and Ann laughed at the sight.

"And you two are missing the bigger puzzle," Joshua added. "The Trans-Aryan Alliance doesn't give clues on how to break into its installations."

Junior placed explosive charges on the turrets and Lucas programmed the detonators to trigger should the cannon covers unexpectedly spring open and the lasers attempt to fire. Joshua brought *Raven* in, "mooring" a kilometer off the station. They loaded the skiff, flew into the garage, and reacquainted their legs to spin-gravity.

They sealed the pressure tent around the entry, and stripped from their outside space suits down to helmeted, fully-insulated anticontamination suits. While Joshua pressed welding-torch flame to metal, Ann clutched her bioscanner and Lucas, muttering, tapped candidate-passwords into the keypad with thick-gloved fingers.

"There!" Joshua announced. They helped him extract the meter-square plate he'd cut.

"Uh," Lucas said. "I guess there's no comfortable way to say this, but I was thinking ... if this *is* a Trans-Aryan bioresearch installation, and if they *are* developing designer-plague viruses targeted on ethnic genotypes like everyone suspects they are ... then, well, since you're not ethnic-European, maybe you guys should stay here. ..."

"We'll be safe in the anticons," Joshua said. "What do you think, Ann?"

She nodded, but her wide eyes hinted a different response.

Joshua crawled into the airlock. The others followed, Lucas last and a tight squeeze. The inner door opened with the touch of a button.

A corridor led to a stairway, which led into darkness.

"Pressure, temperature, humidity are normal," Ann said.

"So the Keeper's not totally daft," Lucas said.

Joshua casually unholstered his gun. The others copied. They climbed the steps together.

At the top was a silent jungle, and it was night—and then it was day. And

then it was night.

The station had the proportions of a gigantic bicycle tire. Standing on the inside of the outer rim, Joshua had his head oriented toward the radius, and when he looked up, he saw the glass roof, about thirty meters above. Beyond the roof, the station's ring split a sky of tumbling stars—through which a mirror-reflected sun rose and set once every three minutes. The roof glass was transparent in one direction only. He could see up through the roof directly overhead, but not down through the roof elsewhere.

He lowered his eyes. The floor curved out of sight. It was carpeted by plants, bushes, some trees. A sprinkler system hissed and misted the vegetation a hundred meters antispinward. Spinward, steeply-slanting sunlight splashed over a trio of one-story buildings. The segment of sunlight rushed past the buildings and toward the visitors, and then past, in a perpetual loop.

Joshua started down a weed-grown trail. Ann and Lucas followed, spread out by ten meters. No one spoke, even when a crow cawed from a high perch. They kept their helmet lamps off. The radar/infrared proximity-scanner cradled in Joshua's gloves showed no bodies in motion among the brush—other than rats.

The foliage thinned into a clearing, and there were the buildings. LAB 01, read the sign on one building, LAB 02 and LAB 03 read the others. The doors, bearing the scimitars of biohazard symbols, were wedged open. Leaves and dirt trailed inside, along with paw prints—and a small human footprint.

"A child," Ann said.

"Probably a member of a researcher's family," Lucas said. "That's how these installations operated. Having the researchers isolated in their own colony for years at a time allowed them to merily invent diseases without distraction—or danger to the general Alliance population, if ever there was a biohaz-

ard breach."

"Looks like there was a breach here," Joshua said.

"I can't imagine anyone bringing children into a place as dangerous as this," Ann said.

"They didn't think it was dangerous," Lucas replied. "Any more than you think it's dangerous to have your own daughter living inside a pressurized eggshell here in the asteroid belt, surrounded by high vacuum and flying mountains and cosmic radiation."

"New Seattle is a lot safer than Earth," she replied. "No crime, no war, no police state. But even on Earth, very few neighborhoods have biowarfare laboratories next door. What kind of parent would bring a child here?"

"Well, people who already have kids usually don't volunteer for this kind of duty. But then, pregnancy happens."

"Yes, it does," Ann said. And she had nothing more to say.

"Let's go in," Joshua said.

Helmet lamps on, they entered. They saw fractionators, analyzers, racks of bottles and test tubes. They found cages, empty of animals. And lots of vats, caked with indescribable slime.

Then they encountered what remained of the researchers.

Ann turned away. Lucas swallowed solemnly. Joshua was stone-faced, but he was the first outside.

"This job's not worth it," Lucas said. "We'd have to sterilize anything we take. And if we miss one little spot—"

"Can you download the data files over to Hermes?" Joshua asked.

"We'll have to find the control center first, but—sure, I think so."

"I think we'll stop with that. It should satisfy Thornby. And the sooner we—"

The proximity-scanner display in Joshua's hands flickered, indicating a moving heat source in the brush a few meters away. It was much too big to be a rat.

In unison, they raised their guns and parted into the shadows.

The display showed the heat source was on the other side of the clearing. It was a little over a meter tall, and standing upright.

Lucas whispered over the helmet radio: "I don't see..."

"*Quiet!*" Joshua snapped.

They waited another minute. The leaves on the other side of the clearing shook, and the scanner indicated the heat source was receding.

"Follow," Joshua said.

They pushed through brush and thickets, past greenhouses, barns, sheds, labs, homes, warehouses. Weeds claimed gardens, vines matted walls.

The station rotation carried them into sunshine. Their infrared quarry vanished in a dazzle of leaf glare. Rotation carried them back into dimness. The heat source was a mere dot. Joshua sprinted—and halted at a new clearing's edge.

In the center was an open shed. A single electric light bulb burned from a fixture. Inside were tables, chairs, pillows, blankets, books—and strewn everywhere, stuffed animals and other toys.

"It's like a kid's playhouse," Ann said. "And what a mess!"

"The food on those plates looks fresh," Joshua said. "Look at that open juice bottle—it hasn't evaporated yet. This place has been occupied recently."

"The squalor," Ann said. "It reminds me of my daughter's bedroom every time I come home."

"No comparisons with my cabin, please," Lucas said.

"I think I understand what you're getting at, Ann," Joshua said. "The Trans-Aryan Alliance is socially regimented. It doesn't let its children run wild."

"And this place has 'wild children' written all over it," Ann said. "And with no one picking up after them... I wonder if there are adults around."

"According to my scanner," Josh said, "the heat source we followed here was the size of a child."

"So do we make contact?" Lucas asked. "And how?"

Ann, gazing at the shed interior, drew herself up, and stepped into the open.

"You two stay here," she said. "I think this job's for me."

The men held their guns ready, and Ann wandered into the clearing, her own pistol holstered. When she was halfway across, a small rock flew out of the brush, and bounced against her anti-con padding.

"Hold your fire," she said over the radio.

She entered the shed, and headed directly for the very rear; she must have seen something there. She pulled it out, and they saw it too: an acoustic guitar.

Removing her thick outer gloves, she sat down, tuned, and began to strum and pluck. The music was soft and gentle, soothing and sweet. Ann hummed in time.

Lucas whispered over the radio, "Is there method to this—"

"SHHH!" Ann and Joshua hissed.

A branch near the shed shook. Joshua grabbed Lucas by the gun hand, but Lucas was immobile.

A tiny creature emerged from the brush. It was filthy, and wore rags. Its hair was tangled with leaves and twigs, virtually a nest. It had bare, human feet.

It walked over and stood in front of Ann. Ann glanced up briefly, then concentrated on fingering strings through the triple nitrile layers of her inner gloves.

"Hello," the creature said.

"Hello, little girl," Ann said. "What's your name?"

"Teresa," replied the creature—whom Joshua realized really was a normal human girl under all that mess.

"Teresa is a pretty name. I'm Ann."

"That's nice, too."

"Do you live here, Teresa?"

"Yes."

"With your parents?"

"All the adults are gone now. Just us kids."

"That's too bad. Would it be all right if my friends join us? They're big, but don't be afraid of them. They're really nice. And slow, too. You could probably run circles around them."

Teresa stared at Joshua and Lucas, and nodded. The men loped into the clearing, lumbering like arthritic sloths.

Teresa stared at Ann. "How come your skin is so brown?"

"It's just the way I am, hon. It's okay."

Teresa pointed at Joshua. "How come his eyes are like that?"

"It's just the way he is, hon. It's okay."

Teresa pointed at Lucas. "How come his belly is so big?"

A pause. "Well, he could stand to lose a little—"

"You've never complained before," Lucas murmured.

Joshua skirted around Teresa, and entered the shed. He flipped through a row of books: *Alice in Wonderland (Authorized Version)*, *Approved Jokes and Riddles for Children*, *The Littlest Aryan*, *Operator's Manual for Mark IV Genetic Sequencer*. There were also holophotos of very young children and babies held viselike by grim-faced men and women.

Teresa touched Ann's helmet. "How come you're wearing this?"

"It's to protect us, hon."

"From the vire-ziz." Teresa nodded deeply, and spoke with a child's gift of understatement: "They're bad."

The bushes were rustling. One by one, other grimy children emerged. All were blue-eyed and blonde, of course. Ann resumed playing, and gradually the children—a half dozen—encircled. For reasons known only to himself, Lucas took to doling out the stuffed animals and dolls.

"Notice the ages?" Lucas asked.

To Joshua, the children appeared to be—allowing for malnutrition and stress—no younger than seven, and not much older.

"Like no one's survived puberty in the past seven years," Joshua said.

"Could be this station developed an age-targeting virus. I can't think of any rational purpose for that, though."

"You get rid of the troublesome adults," Joshua said. "Then you can raise up a generation of compliant serfs."

"Yeah. Well. What's a frontier of science if you can't abuse it?"

Ann stopped playing. "We won't abandon them, will we?"

"It . . . complicates matters," Joshua said.

Joshua skimmed through the children's books, trying to think of what to do next. He was spared that problem, however, by a call from Hermes.

"We've got company," Hermes announced.

The other ship (Hermes recounted) had been detected through its stealth countermeasures only moments before. It was a thousand kilometers from the station, and closing at two thousand kilometers per hour. The telescope showed the flaring laser ports and bulging missile tubes of a Trans-Aryan Alliance patrol craft, smaller than *Raven*, but far deadlier.

"Hermes," Joshua said. "Move *Raven* as necessary, so that the station is always between it and the other ship. Do you understand?"

"Yes, Joshua."

Joshua looked through the roof. *Raven's* thrusters silently glowed, and the ship gently drifted over to the other side of the station, taking position alongside the rim. Rotation flashed them past, and then *Raven* receded to the far end, and then it came back again. Joshua stared, lost in thought. Then he took out his computer tablet and reviewed the tactical display generated from Hermes' telemetry. Range eight hundred kilometers and closing. It wasn't decelerating.

"Coming in for the kill," Lucas said. "This is damned coincidental, them showing up so soon after us."

"The Trans-Aryans spy on Avalon all the time," Joshua said. "They've probably

been tracking us since the day I left Thornby's office. This . . . this is my fault, for getting us involved in cloak and dagger."

Joshua sat down. Teresa came over and peered at his computer tablet, observing the icons creeping across the screen.

"Is that a computer game?" she asked. "Our computer games stopped working a long time ago. Now all we have are books."

"Ann. . ." Joshua called.

Ann came over. "Come here, honey." She took the girl's hand, but then she saw the tablet herself. "What's going on?"

Joshua turned away and blinked, took a deep breath and exhaled.

"Hermes," he said over the radio. "Send a standard greeting to the ship."

"I have done that already, Joshua. There has been no response."

Lucas and Ann were staring at him, waiting. Joshua opened his mouth, but that did nothing to prompt words.

"*Raven* might be able to hide from laser fire," Lucas said. "But once they get close enough to drop a smart missile—"

"They're going to destroy *Raven*," Ann said. "Then they'll board the station and come for us. They won't let us live as witnesses—"

"They'll probably nuke the whole station," Joshua said. "That'll take care of witnesses—and evidence."

Joshua raised his eyes roofward, pleading with the stars. They had no answer.

"We have to defend ourselves," Lucas said. "But with what? *Raven*'s weapons are no match for a real military ship."

Gazing through the glass roof at the station's central axis, Joshua's eyes fell on the turrets. Lucas followed Joshua's line of sight, and his own eyes widened. He nodded rapidly.

"We need to find the control center," Joshua said. He looked at the little girl alongside Ann. "Ter—Teresa. Do you know where the control center is? It's

a—"

"I know where it is," Teresa said.

They followed her down a narrow trail. It was only a hundred meters away. The door was closed and locked and there was another alphanumeric keypad alongside, with a monitor reading: A CHILD SHALL LEAD . . . and Joshua realized the irony.

"We don't have time for this," Lucas said. He strode to the door, placed an explosive charge, and they retreated and took cover, Ann clamping her hands over Teresa's ears.

A flash and boom, and Lucas leaped forward. Passing through wisps of smoke, Joshua and Ann found him seated at the main workstation, hands poised above the keyboard. He was squinting at a monitor coated with dust.

"Oh, Hades," Lucas said.

ENTER PASSWORD, the screen read.

The tactical display on Joshua's tablet showed the patrol ship closing within five hundred kilometers. Fifteen minutes. While Joshua's mind remained frozen in neutral, Lucas bounded out of the chair and over to the server racks. He pried off the covers and glared at the circuitry modules.

"If I can figure out where exactly they're storing the password," he said. "I could isolate the module and logic-probe it."

"How long will that take?" Joshua asked.

Lucas deflated. "Too long."

Joshua touched his computer tablet, summoning a window with the words that had been radiated by the beacon, the words that had appeared over the door keypads, the words that—what? He wondered if he had a glimmer of the truth, that the words were not entirely the madness of a machine.

"*A child shall lead*," he said. "Well, a child did lead us here. Teresa."

Teresa, thoe only child to come inside, clung to Ann, but met Joshua's gaze.

Joshua turned the tablet screen toward the girl, and softened his voice: "Teresa, do you know what these words are about?"

"The riddle," she said.

"The riddle," Joshua said, glancing at the other adults. "What is the riddle for?"

"It makes the Keeper obey you."

"Do you know the answer to the riddle?"

"No. We're supposed to figure it out, but no one can."

Joshua looked at his screen. "*A child must read.* Can you read, Teresa?"

"Yes. Kind of."

"Can you help us solve the riddle?"

"I tried, a long time ago. I couldn't get it."

"Well, we'll work together, and maybe we'll just take one part at a time." He laid the tablet on the workstation counter, and placed his hands to block out all but one line of the riddle. He recited: "*Once in life and twice in resurrection.*" Do you know what that means?"

Teresa stared for a long time, mouthing the words as she moved her finger from one to the next.

"Does she even know what 'resurrection' means?" Lucas asked.

Ann gave him a sharp glance.

Teresa continued staring. Joshua watched her eyes dart back and forth between the words. He tried to delve into his own childhood. *Word puzzles.* What were they all about?

Lucas took out his own computer tablet, summoning the tactical display. "Ten minutes," he mumbled. But his sagging features said all that needed to be said.

"Maybe the password has something to do with the children's names," Ann said.

"I think it's something else," Joshua replied. He saw a faint glow in Teresa's eyes. "Do you have a guess, Teresa? Any guess?"

"Well," Teresa said, tilting her head.

She pointed at the tablet screen. "There's one of these in this word, and two in the other word."

"Oh great!" Lucas said, rolling his eyes. "That really—"

Then comprehension dawned on all of them at once.

Lucas pushed Joshua away from the console, wiped the dust off the monitor, and jabbed a finger upon the keyboard.

"Read 'em out to me as she gets them!" he cried.

Actually, Joshua helped, and then Ann joined in, and soon they had most of the password figured out. But then, with five minutes remaining, there was a glitch. They reviewed their work, again and again. The Keeper kept rejecting their inputs.

"*We enter*," Joshua said finally. "It's got to be the last line that's the problem. Everything else *has* to be right."

Ann scowled . . . and then slowly grinned. "Oh, I get it!"

"Well?" Lucas demanded.

"Well, what *are* 'we'?" She pointed between herself and him.

"*We are dead*, if you don't tell us!" Lucas shouted. "Don't tease, Ann—we've got less than a minute!"

She bumped his shoulder hard as she tapped in the last two letters herself—and pressed the Enter key.

On the control center monitor, the password window vanished and a beltwide-standard Keeper interface appeared.

"Ready for command input," the Keeper crackled over the room's loudspeakers.

"Joshua!" Hermes cried over their helmet radios. "Missiles en route!"

Joshua grabbed Lucas's tablet. On the tactical display, a quartet of missiles streaked toward the station and ship. Time had run out.

"Imminent tactical threat," the Keeper said. "Request permission to defend."

"Deactivate the charges on the shutters first," Joshua said to Lucas.

Once Lucas did that, Joshua instruct-

ed the Keeper: "Fire lasers!"

The cannons vaporized the missiles within a few thousand meters of the station. The patrol ship loosed another volley—but the Keeper was swifter, flashing the missiles into incandescent clouds the instant they cleared their tubes.

Joshua watched the brief exchange conclude on the workstation monitor. Then he summoned the Keeper's tactical display onto the monitor, and pressed his thumb on the touch-sensitive screen—atop the patrol ship's symbol.

"Now let's send *them* a message," he said.

For the second time in a month, Joshua Wang leaned against the veranda rail of the security complex of the artificial world known as Avalon. The sunshine was still as bright, and the parrots and sailboats and monorail were still there. This time, however, there was no tea or roboserver.

He met the eyes of the director of security.

"We fulfilled your terms," Joshua said. "You have no right to hold my ship."

"Come into my office," Nigel Thornby snapped.

This time Joshua hung back as Thornby typed in the password. As the windows darkened, Thornby swiveled to glare at him. Joshua lounged in a chair and hesitantly smiled back.

"We fulfilled *your* terms," Thornby said. "Prompt payment of fifty kilos platinum to the Bank of Ceres. Full rights to hardware salvaged from exterior of station. And the children are being released from quarantine and into a guardianship that met your crew's approval. So why are you holding back critical military intelligence?"

"The message isn't military intelligence."

"Our best crypto-analysis team can't crack it!"

Joshua's smile went tight. "It's not in-

tel and therefore not part of our original deal. And since you're being rude about it, it'll cost you another fifty kilos to find out just what it is."

"Your ship will *never* leave!"

"Why don't we make it *sixty* kilos? That'll be easier to divide."

They locked eyes. Finally, Thornby said, "All right."

The exchange of Bank of Ceres transaction codes took only a moment for their computers to process.

"A little background," Joshua said. "The virus was designed to kill adults only, leaving children for capture and cultural and economic absorb—"

"We've shown the evidence to the Nova Americans, thank you very much. Now, what about the Keeper's message?"

"Well, when the virus breached the containment and people started getting sick, the station personnel realized that their government would just as soon let them all die rather than risk the spread of contamination to rescuers. So they steered the station on an intercept course with Avalon, to seek asylum, stealthing and maintaining radio silence at the outset, so that they wouldn't be followed."

"And what does that have to do with the Keeper's message?"

"The adults were dying, and they had to decide whether to let the station's Keeper run itself—or put it under the control of what were, at the time, very young children. Well, AIs have a tendency to miss context—just like very young children have a tendency to lose focus. So neither alternative was good."

"*The message!* What about the *message?*"

"Think of that last adult alive on the station. He's in a fever, yet he's got to decide who gets ultimate control of the station—Keeper or kids. Finally he comes up with a compromise. For the time being, he puts the Keeper in auto-command mode and doesn't tell the computer system password to the chil-

dren. But he does write a riddle, with the password as the solution—and he makes sure the Keeper displays it prominently. He figures that when the children grow older, they'll be smart enough to solve the riddle—and that means, at that stage, they'll be smart enough to take command of the Keeper."

Thornby tapped his keyboard, and the words appeared on the wall screen: "*A child shall lead, a child must read ...*" How do you get a computer password out of that?"

"You don't. Those are just instructions. The password clues begin on the next line."

Joshua walked over to the screen, and pointed: ONCE IN LIFE AND TWICE IN RESURRECTION.

"Now," he continued. "What occurs once in life and twice in resurrection?"

"I don't know ... birth?"

"We're not looking for metaphysical answers, we're looking for a computer password. Passwords are made up of letters of the alphabet. Now, what letter of the alphabet appears once in the word 'life' and twice in the word 'resurrection'?"

Thornby's mouth slowly dropped open.

"The letter 'e,'" he said mutedly.

"Right. Next line: *'In wind and in fire.'* Well, only the letter 'i' appears in both the word, 'wind,' and the word, 'fire.' Next line: *'The beginning and end of stars.'* The letter 's' appears at the beginning and end of the word, 'stars.'"

"What about, *'When it leaves time?'*"

"Take the letters 'i' and 't' out of the word 'time,' and you've got 'm' and 'e' remaining."

"*In words but not wisdom. ...*"

"The letter 'r' is in the word, 'words,' but it is not in the word, 'wisdom.'"

"Oh."

"Now the last line was a doozie, even though it seems very simple: *'We enter.'* Sounds like you just type 'w' and 'e' and press the Enter key, right? I thought so. I

almost died thinking so, because the Keeper kept rejecting it. But Ann figured out that 'we' is actually composed of two other letters."

"It is?"

"Yes. 'We' is made up of 'you' and 'I'—the letters 'u' and 'i,' that is."

"Oh. ..." It sounded like a groan.

Joshua patted the screen. "Put them all together, you have the password: 'E-I-S-M-E-R-U-I.' Which is completely random, out of over two-hundred billion possible eight-letter combinations, according to my ship's computer geek. Not likely to be found by trial-and-error in a reasonable length of time, and I doubt there's a crypto-analyzer anywhere in the Belt or on Earth that could have cracked the Keeper's riddle. Because they would be looking for the wrong thing, of course."

Joshua spread out his palms and edged toward the door.

"So you see," he continued. "I was telling the truth. It was not military intel. So, you'll let my ship go now?"

"Just a moment." The security chief scowled. "You think I'll let you leave with an additional sixty kilos, just for *that*?"

"We gave the password to your people first thing, and now I've told you how we cracked it. So we've earned the money fairly."

"And just how do I go to the Avalon Supreme Council and justify the organizational budget expenditure of sixty kilos of platinum—for the solution to a child's riddle?"

"Would you rather I go to the Council—and ask why *you* couldn't solve a child's riddle?"

Thornby's face went blank and colorless. He spread his fingers on his desk and examined them. Finally, he mumbled: "Take your ship and leave."

Joshua opened the door and stepped through. But then he smiled and turned.

"If they do ask," he said, "just tell them you didn't have a child." ■



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Solving the RHIC Puzzle

I do not usually write about my own scientific work, but I'm going to make an exception for this column and tell you about a physics puzzle and how we solved it. Back in 1991, almost a decade before the facility actually went into operation, I wrote a column ("RHIC: Big Bangs in the Lab", *Analog*, June 1991) about the Relativistic Heavy Ion Collider (RHIC), a large accelerator project that was then in the early stages of construction. The column was written a few months after I joined what is now called the STAR Collaboration, a group of physicists (now numbering 577) who ultimately built a large "time-projection chamber" detector for tracking and making measurements on the charged particles produced in RHIC collisions.

The RHIC facility is actually two ring-accelerators that accelerate heavy nuclei in opposite directions to nearly the speed of light and then bring them into collision, creating an ultra-hot "fireball" from nuclear systems meeting head-on. RHIC was designed to create a *quark-gluon plasma*, a new state of matter that has not yet been studied. Standard cosmology says that this was the state of the universe in the first few microseconds after the Big Bang, at the time when the cosmos cooled to a plasma of quarks and gluons, but was not yet cool enough to make the transition to a "soup" of nucleons and mesons, followed by electrons and nuclei, then atoms and photons, etc. The quark-gluon plasma represents new and unexplored territory in the domain of nuclear and particle physics. Exploring this quark-matter territory could sim-

ply provide a confirmation of our present ideas about matter under extreme conditions, or it could reveal new and unanticipated wonders. If the history of accelerator physics is any guide, one can expect surprises when a new accelerator facility opens up unexplored territory, and indeed there have been surprises (and puzzles) coming from RHIC.

The RHIC facility was completed in 1999. However, the initial attempt to produce collisions with RHIC in the summer of 1999 was unsuccessful. It was ultimately discovered that the machine had been damaged by wrong-headed pressure tests before operation began and that expensive repairs were needed. The RHIC collisions and measurements finally began in 2000. There have now been five years of running, and a great deal of data has been collected at the two large RHIC experiments, PHENIX and STAR, and also at the two smaller experiments, BRAHMS and PHOBOS. The data has produced much excitement and much progress has been made, but up to now, the data has been telling a confusing story.

To understand the confusion, we have to talk a bit about the conditions in a quark-gluon plasma. First consider what happens when a gas of hydrogen atoms is heated until the orbiting electrons come loose. In the gas, electrons are bound by electrical forces to protons that form the nuclei of hydrogen atoms. When the energy gets high enough, the electrons are detached from the protons. When this happens, the gas becomes a *plasma*, with a "fluid" of charged elec-



Art by Wolf Read

trons sloshing back and forth against the more massive “fluid” formed by the protons.

By analogy, at the much higher temperatures available at RHIC we should be able to do the same thing with nuclei. Each proton and neutron in a nucleus can be considered as a “bag” containing three *quarks* held together by the strong force, which is moderated by massless particles called *gluons*. If we subject the system to enough heat and pressure, the quarks should be surrounded by gluons, pulled in all directions by color forces, and should become relatively free particles, no longer constrained to stay in their bags in groups of three. At RHIC, where gold nuclei are brought into collision at energies of up to 200 GeV per nucleon, theoretical lattice-gauge calculations indicate that a plasma made of quarks and gluons should be produced.

The problem with verifying that a RHIC collision produced a quark-gluon plasma is that such a QGP state would

be present early in the collision for a very brief time, after which the system expands and cools to become a collection of baryons (3 quarks) and mesons (quark-antiquark pairs) going their separate ways. With the STAR detector, we must measure this “debris” of baryons and mesons from a collision and attempt to deduce what happened in the early stages of the collision.

Even if we are constrained to view only the aftermath of a RHIC collision, the prospects for finding that a QGP was present are not hopeless. There are several characteristic signals of a QGP that can be looked for. First, it should have a very high initial pressure. This should accelerate the particles coming from the collision more in some directions than others, and should produce a characteristic “elliptic flow” pattern in particles emerging from the collision. And indeed, such an elliptic flow pattern was one of the first signals observed in RHIC collisions.

Another characteristic of a QGP is that it manifests the strong force at its strongest, without the shielding and cancellation that occurs when quarks form mesons and baryons. Therefore, the very energetic particles that are created early in a collision and that must pass through a QGP on their way out should interact strongly with it and should have a high probability of losing energy or disappearing completely before they escape. And indeed, such disappearance of the most energetic mesons and baryons is another signal that has been observed to be present in RHIC collisions.

If we stopped there, we might say that two independent signals are telling us that a quark-gluon plasma has been created in RHIC collisions. However, there is a severe problem. The size, shape, and time evolution of the fireball emitting pions (i.e., "pions," particles made of a quark-antiquark pair) can be measured using a technique called "Hanbury-Brown Twiss interferometry" or HBT. It is used on pairs of pions from the collision, looking for an enhanced probability of such pairs that are close in momentum.

Since a quark-gluon plasma has many more particles and quantum numbers than an equivalent fireball made of baryons and mesons, it has more ways of squirreling away energy and should be slower to release that energy. Therefore, if a QGP lies at the heart of a RHIC collision, the resulting fireball should grow larger in size and should expand and emit particles longer than a fireball that never made a QGP. Therefore, the pre-RHIC theoretical expectation was that when HBT interferometry was done on RHIC collisions, one would see a very large source (10-20 femtometers or fm) that emits pions for a long time (3-10 fm/c).

However, the actual measurements seem to say otherwise. The measured source sizes are about the same size as those from lead-lead collisions measured on other accelerators operating 10 to 100 times lower in energy. The source

size at RHIC shows no dramatic growth. Further, it appears that the pions are emitted *explosively*, in a time so short that it can't be measured (less than 1 fm/c). Instead of bringing the nuclear liquid to a gentle boil and observing the "steam" of a quark-gluon plasma, the whole boiler seems to be exploding in our faces! This mysterious behavior is now called the "RHIC HBT Puzzle." It has proved to be a serious barrier for those who would like to announce that the quark-gluon plasma has been discovered at RHIC.

I am an experimental physicist who was one of the founding members of the STAR Collaboration. I have been one of the leaders of the STAR HBT interferometry work at RHIC. But I sometimes also do theoretical studies, and perhaps $\frac{1}{4}$ of the roughly 200 papers I have published over the years are in theory rather than experiment. And I had an idea about what might be missing from the theories that predict large sources and long emission durations at RHIC. I suspected that the problem was that those theories were not using quantum mechanics to describe the pions from the fireball, and in particular were not including the possibility that these particles could be deflected or absorbed on the way out of the fireball. Fortunately, one of my theorist colleagues at the University of Washington, Gerald A. Miller, is a master at performing just the kind of calculations needed, and I was able to interest him in joining me, along with a graduate student and a visitor, to form a group that tried this approach.

Our work took about two years. We formulated a relativistic quantum mechanical description of the problem, wrote a computer program that could predict HBT source sizes, emission durations, and pion momentum distributions, and then hooked this program to a "search code," a program that would systematically vary the variables used in the program to fit data measured by the

STAR detector for collisions of gold nuclei at the highest RHIC energy. When we looked at the data-fitting results, we found a surprise.

We had begun the work with the assumption that the important missing ingredient in the previous theories was that they ignored the absorption and loss of pions on the way out of the fireball medium. We had also included a "potential well" that describes the deflection and energy change of the particles, but we didn't consider it to be very important. But when the fitting began, we found that good fits could only be obtained if we started the pions at the bottom of a very deep potential well and made them use most of their kinetic energy to climb out and escape. The well needed was so deep that it roughly equaled the mass-energy of the particles. This could be interpreted as saying that the pions were losing most of their mass in the fireball medium.

That numerical result triggered a flash of insight. In vacuum, a pion has a mass of 140 MeV, but in the hot dense medium of a quark gluon plasma, the standard model predicts a "chiral symmetry" phase transition that makes the particles lose most of their mass for two reasons: Surrounded by external color forces, the size of the pion grows, reducing the internal motion that accounts for most of its mass. Further, the quarks lose the "dressing" of virtual particles they had in vacuum, and they become essentially massless. Therefore, pions in a region where chiral symmetry has been at least partially restored should lose most of their mass. They would have to do work against a deep potential well to regain their mass when they emerge into the vacuum. Our fitting results were pointing to chiral symmetry.

And so we built the characteristics of chiral symmetry into our program and re-did the fits. The results were spectacular. All the data could be fitted with reasonable values of the fitting variables. And the calculations showed that the ap-

parent small source size and short emission duration of the analysis had been illusions produced by the deep well from which the particles were emitted and by their absorption on the way out of the fireball. The actual source was larger and emitted longer.

According to most theoretical descriptions of hot dense media, a quark-gluon plasma and chiral symmetry restoration should happen at about the same temperature and pressure. The deep potential well that emerges from our results provides evidence that a chiral phase transition has occurred in the collision. By implication, therefore, it supports the picture that RHIC collisions are producing a quark-gluon plasma. Our results have converted a problem for the QGP interpretation into another piece of evidence in support of it.

In other words, we have solved the RHIC HBT Puzzle. The problem was that previous theoretical treatments were leaving out quantum mechanics, were leaving out the loss of pions in the medium, and were leaving out the deep potential well from which the pions must emerge. When those elements are added, all the pieces click into place and the puzzle is solved. Our paper describing this work has just been accepted for publication in the journal *Physical Review Letters*.

AV Columns Online: Electronic reprints of over 120 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available online at: <http://www.npl.washington.edu/av>. The paper referenced below can be obtained at: <http://www.arxiv.org>.

Reference:

Solving the RHIC HBT Puzzle

John G. Cramer, Gerald A. Miller, Jackson M. S. Wu, and Jin-Hee Yoon, "Quantum Opacity, the RHIC HBT Puzzle, and the Chiral Phase Transition", *Physical Review Letters* (accepted for publication), electronic preprint nucl-th/0411031. ■

The Time Traveler's Wife

Scott William Carter

There are two main ways to the future. . . .

Years later, when the history books were written about the only known time travel experiment, it was said that Yolanda Green was not at all like her husband.

Yolanda was an even-keeled, mostly content person, who hummed her way through life. The ambitious Dr. Horace Green, known world over for his improvements to the subatomic laser, was usually depressed and irritable, and he never, ever hummed. Yolanda had a stress-free job as church secretary, spent her free time knitting sweaters for her nephews and playing bridge with the Evergreen Women's Club, and her only true aim in life was to have a house full of children.

This goal, however, required the participation of her husband, whose desire to start a family ranked somewhere below his desire to spend more time on university committees. Still, she needled him with suggestions, tried to plant the seeds of it in his mind—"Oh, this back-

yard will be great for our kids, one day!"—all the while, waiting patiently for him to capitulate.

All her fancies seemed to blow out like candles in the wind one day when he made his announcement at dinner.

"We've done it," he said. "Three times with a mouse and five times with a monkey. The university has approved my request for a manned test run. We're going into the future!"

He had the gleam of excitement in his eyes and the flush of pink on his baby-smooth cheeks. When they were fifteen, it was his enthusiasm that made her fall in love with him.

"I'm proud of you, dear," she said. "Who will be the lucky time traveler?" And her voice cracked because she already anticipated his answer.

He looked down at his egg salad and responded in the voice of a child: "Why, me, dear."

"You? But you're the project leader. Wouldn't one of the grad students be a

better choice?"

"I can't make them take that risk. Besides, I've worked all of my life on this." He reached across the table and took her hand. "You've seen what's happening. I've got to believe that in a hundred years all our problems—poverty, war, disease—will be solved. So I'm doing this for us, dear, for our unborn children. I've got to give them a vision of the world the way it will be."

"You'll come back, won't you?"

"Of course, dear! I would never leave you behind. I'll be back for dinner as usual."

Of course, Dr. Green did not show up for dinner as usual. Instead, a portly man in a gray suit showed up at her door with the news that her husband had not returned according to schedule, and the schedule, when it came to time travel, was everything. There was no guarantee he wouldn't show up at some point, but it was also possible that something prevented him from returning.

The news of the experiment leaked out, and all the tabloids ran with it. "Scientist Vaporizes Himself in Attempt to See Buck Rogers." Her friends gave her sympathetic looks, which were unbearable—unbearable because they knew, like her, that she would never have children unless she had them with another man. Since she had never loved anyone else, this thought was unthinkable to Yolanda.

Eventually the public's interest in her faded. Since the insurance provided more than enough money to take care of all of her needs, she spent her days knitting socks her husband would never wear, and her nights listening to the old grandfather clock ticking away the hours. She watched in grim silence as her husband's fears about the world were confirmed. Violence, poverty, starvation, plague—all of these became facts of life, and each year it worsened.

To escape from witnessing such despair, Yolanda began to read.

She had never read much before, so her skills were limited. Her husband had an extensive library, so her choices were varied. She read Dickens, Alcott, Bronte and Austen. Her skills improved and she tackled Faulkner, then Conrad and Camus. She had never been educated beyond the eighth grade, and with each book, her understanding of the world deepened. She worked her way through their set of *Britannicas*, then moved on to Plato, Aristotle, Nietzsche, and Marx. Soon she had exhausted her husband's collection and she began to visit the library. The librarians soon knew her by name.

The years passed and one day Yolanda received an official-looking letter in the mail. It bore the Presidential seal.

Mrs. Green,

Congratulations on reaching the graceful age of one hundred years!

It bore the President's signature, a stamp she was sure, but it still thrilled her. What astonished her more was her age, for she hadn't given it a second thought.

She had little time to enjoy it. The next day the United States went to war. Yolanda decided right from the start that people needed a message of hope. She started small, with peace sittings in her own city, and letters to her congressman, but her efforts spread. No one knew who she was or even her last name. To those who asked her age, she said simply, "I'm older than most."

When the war finally ended, Yolanda was asked to give speeches everywhere, and she did not disappoint. She called people her children, and she asked them not to shirk their responsibilities. She told them, "If this little old lady can do it, so can you."

Finally, she allowed herself to fade quietly into the background, and made her plans to die. But strangely, the end did not come.

ANALOG

When she arrived at the university, she saw that an oversized grandfather clock had been mounted next to the red-carpeted stage. As the time approached, everyone counted down the seconds. With a voice hoarse from years of giving speeches, Yolanda counted with them. At precisely zero, the egg-shaped metal contraption appeared. No fanfare, no smoke, no lights. The stage was simply bare one moment, then there the time machine sat. The crowd cheered. The hatch popped open and her husband emerged.

He had not aged one day since she last saw him. Dressed in a blue jump suit, he smiled and waved to the crowd. Scientists and journalists immediately converged on him, assailing him with questions.

Yolanda moved toward him, nudging her way through the crowd like a needle through a soft fabric. Soon she stood

near her husband, just outside a circle of people.

"Horace, it's me, dear," she said.

The circle around him parted. When he saw her, his eyes widened, and he moved to her instantly, putting his arms on her shoulders.

"Yolanda?" he asked, incredulous.

"Yes, dear." There was a strange tremor in her heart.

He looked her up and down. "My God," he said, "what kept you going?"

She smiled and slumped into his arms. Her immortal and endless strength had finally deserted her. The people in the crowd—her children, her many children—fell silent, so all could hear her final words.

"Someone had to give you the future," she said.

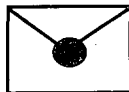
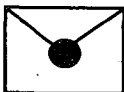
And she realized, finally, why he never came back. ■

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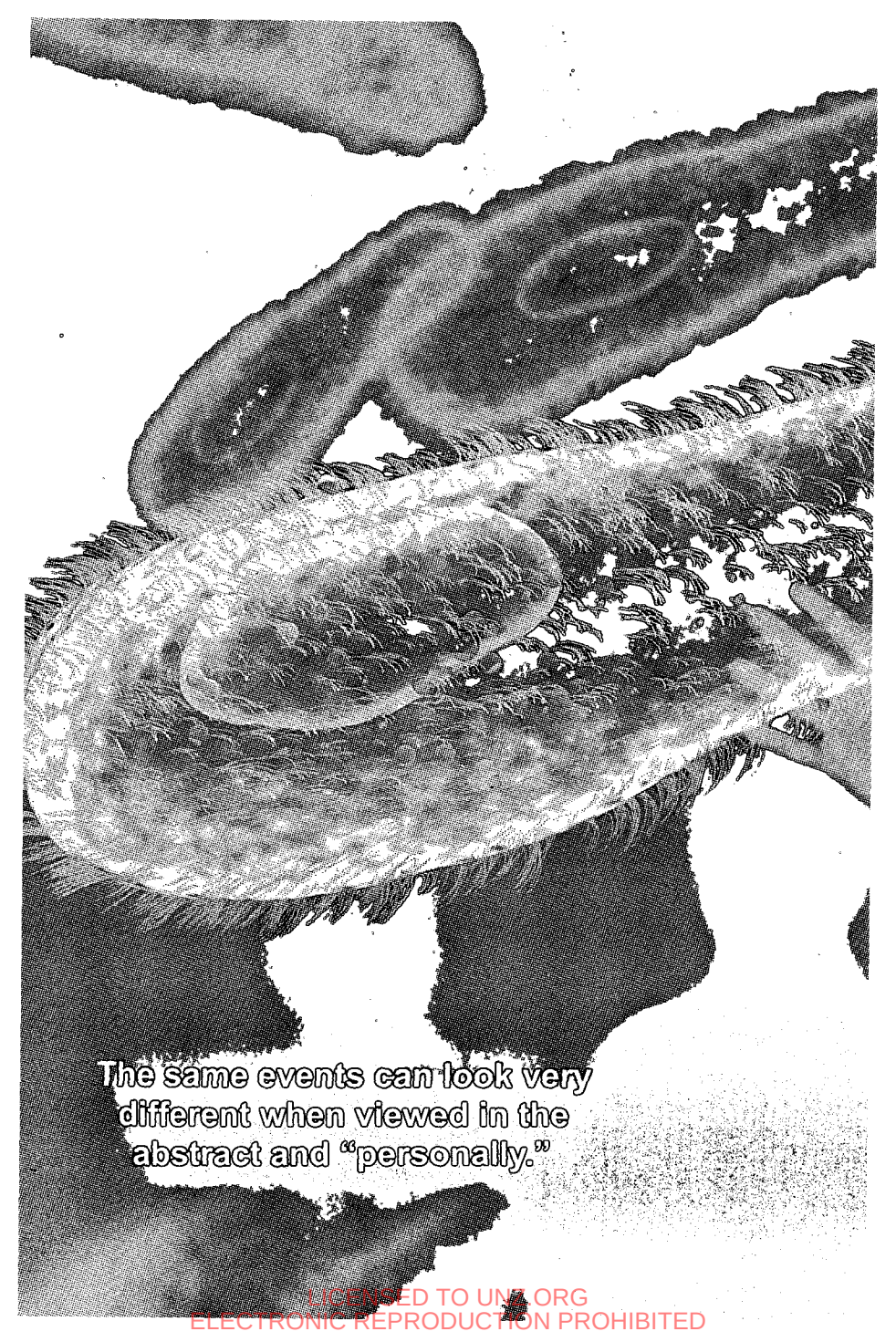
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The same events can look very
different when viewed in the
abstract and "personally."

Prayer for a Dead Paramecium

Carl Frederick



Illustration by Nick Jainschigg

In the lazy morning already hot at ten o'clock, with a long infinite month between them and the start of school, Ralph could for a moment pretend he was happy. He looked up ahead at his kid brother kicking an empty soda can along the sidewalk. Scampering about in his white shorts and blue polo shirt, Alex *did* seem happy. Big important things seemed to wash right over him and last month, he'd taken the news far better than anyone. Ralph felt a twinge of envy.

Further on, although still a ten-minute walk away, Ralph could see the familiar, squat, white building shimmering in the morning sun—The Small World Aquarium. It was Thursday, and the aquarium was free for kids on Thursdays.

Ralph swatted at a mosquito, then cast his eyes down at the sun-baked sidewalk squares and tried to avoid stepping on the cracks—not that it mattered anymore.

He looked up at the sound of the soda can clattering into the street and saw that his brother had stopped at the corner for a red light. Stooped forward with hands resting on his knees, Alex stood peering through the window of a vending box at the front page of the newspaper.

Ralph walked up and, ignoring the war headlines above it, examined the front-page photograph.

"That's a pulsed-energy cannon," said Alex, pointing.

"Yeah," said Ralph, "Shiva-2 class."

Alex touched his finger against the plastic window. "And that's a J7 drone bomber."

"Too big for a J7," said Ralph. "I think it's a J11." He made flying movements with his hand, accompanied by bomb-dropping sound effects.

Then, reflected against the plastic, Ralph saw the light change green. "Come on," he said. "Let's go."

The twin rows of lights embedded in the roadway began blinking amber, defining a crosswalk. It looked like an

airport runway and Alex, spreading his arms and making airplane sounds, buzzed past Ralph into the street.

As Ralph pushed through the aquarium's revolving doors, he felt the familiar shock—as if he'd suddenly been transported into outer space. Instead of squinting against the summer brightness, he peered, wide-eyed, at a world of darkness gradually becoming comprehensible as his eyes dark-adapted. He inhaled the crisp, freshly washed smell of big public buildings and heard the soft hum of air conditioners, a sound like distant engines. Wearing only a thin shirt and shorts, he felt his skin erupt in goose bumps as he adjusted to the abrupt change of temperature.

After the boys passed through the metal detectors and chemical sniffers, they sped by the gift shop and darted over to the game arcade. All the games were free, which was good—and educational, which wasn't. But Ralph's favorite, the Zoazap, was so much fun it was a wonder there was no coin slot.

The arcade was packed; a throng of kids in Scout uniforms hogged every console and a long line stretched out in front of the Zoazap.

"Rats!" Ralph turned and tromped out of the arcade, Alex following. "We'll come back later—after the Scout Troop leaves."

"Doesn't matter," said Alex. "I don't really like Zoazap much anymore."

"You used to."

Alex pointed across the main foyer at a sign, "Hall of the Protozoa," engraved above one of the three wings of the aquarium. "Let's go there. That's the best."

"Okay. Sure."

They walked through an arch, then zigzagged through a light-baffle and emerged into one end of a tunnel. Its roof, curving walls, and even much of the floor were transparent. Looking out, Alex and Ralph could see water and what appeared to be the bottom of a

seabed.

The illusion was perfect. Ralph had taken a "behind the scenes" tour with his school class and knew that it was all done with 3-D holographic projections. In the basement, there was a tiny aquarium with a snazzy underwater, phase-contrast microscope set in the middle of it. But Ralph didn't care. The walls of the hall teemed with life: all freshwater, single-celled protozoa.

A shark-sized paramecium, cilia flailing, flew across the walls, then swam over their heads, and then plunged for the bottom. Looking down through the floor, Alex and Ralph saw the great paramecium foraging for food. Ralph smiled. It looked like the creature could swallow his brother in one gulp.

They'd been here often. Alex ran around the tunnel waving at the protozoa and shouting out their names. He stopped for a moment. "Look. There's an amoeba. And it's eating something." Another animal caught his eye. "*Suctorioria*. It's retracting its tentacles." He skipped down the corridor, pointing out the fauna. "*Dileptus*, *Litonotus*, *Euplotes*, *Logophyllum*."

Alex stopped again, his eyes fixed on a smaller paramecium that was cruising gently back and forth at about eye level. "He's beautiful," he said. "I like him."

As the paramecium glided along, its cilia moving in coordinated undulations, Alex, silent in his sneakers, followed, the tip of his nose tracing a path along the glass.

"Yeah," said Ralph, walking behind. "He *is* beautiful."

"I'm going to name him Perry," Alex moved back from the glass. "Hello, Perry."

"He can't hear you," said Ralph. "He's just a little speck swimming around in some pond water. He's so small, you couldn't even see him."

"I know that," said Alex, but it didn't sound as if he believed it.

Even though Ralph was fascinated by this creature that looked like living silver, he eventually grew bored. "Let's go

back to the arcade," he said, grasping Alex by the wrist and pulling him away. Alex seemed to know better than to protest.

The Boy Scouts were gone when Ralph and Alex walked into the arcade. The really good games still had lots of kids waiting to get at them, but the lines weren't long. Ralph, still holding Alex by the wrist, got in line for the ZoaZap.

Ralph had played this game often: piloting his scout ships through the water, seeking out monsters—giant paramecia—and shooting them. The paramecia were real and you shot them with a real laser. And if you hit a paramecium just right, directly in the center of the main cell nucleus, it exploded.

The line moved slowly, but it moved. Each kid had three minutes at the ZoaZap and for each paramecium destroyed, fifteen seconds was added to his time—up to a maximum of ten minutes. But most of the kids weren't particularly good at the game, and the line moved at the rate of about four minutes per boy; girls didn't much seem to like this game.

After a few minutes of waiting, Alex took a step sideways, breaking free of the swarm of kids. "I want to go back and watch Perry," he said.

"You'll miss your turn."

"I don't care," said Alex. "I don't want to play this stupid game anyway."

"I don't like the idea of you going off by yourself."

"Jeez. You sound like Mom."

"Well," said Ralph, embarrassed to be compared to a female. "Mom says I've got to look after you."

"Come on, Ralphy," said Alex, his high-pitched voice filled with exasperation. "I'm almost nine."

Ralph thought about it for a moment. No way was he going to lose his place in line. "All right. But either stay there in the Protozoa Tunnel or come back here. Don't go anywhere else. Okay?"

"Kay."

Ralph watched Alex go and then

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looked ahead, over a few intervening shoulders, at the ZoaZap screen.

A quarter of an hour later, when he'd waited his way to near the front of the line, he could clearly see the screen and hear the sounds. A boy had just activated the console. On the display screen, Ralph read the words, "SPONSORED BY BRIGHT-SPRING WATER PURIFICATION SYSTEMS AND THE DEPARTMENT OF MILITARY AWARENESS." Then the screen went light blue and the boy set off to kill the evil paramecia—assisting Bright-Spring in its "battle to keep your drinking water safe." The console had good sound effects, yet the boy added to them, whooping and shouting as he zeroed-in on the silvery protozoa.

As Ralph watched the carnage, he heard a distant screaming. It sounded natural—as if it were part of the game. But it grew louder and the sounds didn't seem to come from the console speaker. Then, when the mix of screaming, crying, and sobbing became too loud to ignore, Ralph ripped his gaze from the screen. He saw Alex running toward him. The kid was bawling his head off.

Ralph took a step forward and then moved a leg quickly back, touching the ground with the toe of his sneaker to hold his position in line.

"Alex," he said in a relaxed tone, to make it seem he had only casual knowledge of this noisy kid in front of him. "What's wrong?"

"Ralphy," Alex shouted through his sobs. "Come with me." He pulled at his brother's shirt. "You've got to come."

"Why?" Ralph glanced back over his shoulder. All the kids in the line were watching them. "It's almost my turn."

"Now," Alex screamed, his voice shrill with pain and frustration. "Ralphy. Please." He tugged harder, freeing the shirt bottom from the elastic of Ralph's shorts.

"Okay, okay," Ralph left the line and tucked in his shirt. He felt keenly embarrassed, not only about his brother making a scene, but also about being called

"Ralphy" in public. "Will you quiet down?" he said in a loud whisper.

"Come on!" Alex shouted at the top of his lungs. He grabbed at Ralph's shirt again, but Ralph pushed his hand away.

"Okay, I'm coming."

Alex turned and ran back into the exhibit area, occasionally glancing over his shoulder at his brother.

"Will you tell me what's the matter?" panted Ralph, running a step behind.

"It's Perry," sobbed Alex. "I think he's sick."

"What?" Ralph stopped in his tracks.

Alex spun around. "Please." He grabbed at Ralph's wrist this time. "Hurry!"

"Okay, okay," Ralph, painfully aware that people were staring at them, ran with Alex back to the Hall of the Protozoa.

Alex dashed about halfway down the tunnel, ran up to the glass, looked into the display, and then screamed. He swung around to Ralph. "He's dying."

Ralph looked through the clear wall, near where his brother's runny nose had left a mark on the glass. A paramecium was there, but it was hard to see against the debris on the aquarium bottom—especially since the creature hardly moved. Then, as Ralph watched, the paramecium became still.

Alex shrieked. "He's dead. Perry's dead." The boy cried even more loudly than before, his screams and sobs broken by quick gulps for breath.

"Jeez, Alex," Ralph felt his cheeks flush with embarrassment and then with a sudden anger. "Damn it. You didn't even cry like this when Dad died." Now Ralph's cheeks also flushed from guilt over saying a word he wasn't allowed to use.

Alex continued to cry, but it didn't sound like panic anymore; now the long, mournful wails seemed a dirge for all the sorrows of the world.

Then Ralph heard another sound reverberating against the walls of the tunnel—the crisp, clicking sounds of some-

one walking hurriedly in hard-soled shoes. Ralph looked over his shoulder and saw a man bearing down on them. He was tall. He wore black shoes, black pants, white shirt, and a tie—and he looked angry.

"What's all this noise?" said the man when he'd gotten within speaking distance.

"I think Perry's dead," Alex shouted.

"Who?"

"A paramecium," said Ralph. "My brother named him Perry."

"Oh, for God sakes." The man threw a glance to the ceiling, above which floated a hugely magnified *Litonotus*. Gently then, he peeled Alex away from the glass.

The man looked over at Ralph. "Are your parents here?"

Ralph shook his head.

The man rubbed a hand across his forehead, glanced at Ralph, and then down at Alex. "Okay, then," he said, after a few seconds. "I think you boys had better come with me." He put a palm under Alex's chin, forcing the boy to look up at him. "Let's go to my office. You're disturbing the other visitors and some of the other kids are starting to cry."

Ralph put a protective arm around his brother. He'd been taught to be wary of strangers.

"It's all right," said the man. "You're safe with me." He pointed to his nametag. "I'm sort of the head zookeeper around here."

Ralph eyed the tag; it was above the man's shirt pocket—about where soldiers wore their merit badges.

Dr. Howard Beck
Curator of Protozoa

Alex's crying softened. "Mister Zookeeper," he said, sniffing and wiping his eyes. "Please help Perry."

The zookeeper took a breath and slowly blew out the air. "Come on, you two," he said in a friendly voice. "We'll see what we can do."

In his office, the zookeeper sat the

boys down at a table, then circled around and sat facing them. After staring at each other for a few moments, the zookeeper started talking.

"In a way, paramecia don't really die. You see, when they reproduce, they just sort of split in half." He spoke in a soft, calm voice, like a teacher chatting with a couple of kids who'd arrived early to class. "So when you see a paramecium, it's millions and millions of years old—a part of the original, very-first-ever paramecium."

"Wow," said Ralph.

"And when a paramecium dies"—the zookeeper looked straight at Alex—"it's nothing to cry about. I mean, killing a paramecium isn't like killing a person." He chuckled. "There probably should even be another word for it."

"Killing is bad," said Alex, stubbornly. "Why would anyone want to kill Perry?"

The zookeeper sighed. "You should never have named it." He slapped the table, softly. "Look," he said. "You swat mosquitoes, don't you?"

Alex didn't say anything.

"Come on," said the zookeeper. "I'm sure you've swatted mosquitoes. You know—when your parents take you camping."

Alex gave the hint of a nod.

"And is it okay to swat flies?"

"I guess," said Alex in a small voice.

"How about spiders?"

"Yuck." Alex wrinkled his nose. "I hate spiders."

"All right, then," said the zookeeper. "You probably have mouse traps at home."

"I like mice."

"Okay, rat traps, then?"

"I like rats, too."

"You know what I mean."

"No, I don't," said Alex.

Swiveling his head to follow the action, Ralph felt as if he were watching a tennis match.

"Okay." The zookeeper tapped the table with his fingertips. "I bet you eat hamburgers."

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"Well, yeah," said Alex, suspicion evident in his voice.

Hamburgers! Score one for the zookeeper, thought Ralph. That was his brother's favorite food.

"A hamburger is a cow," said the zookeeper. "You're saying you'll eat a cow, but you wouldn't kill one. Someone has to do it, you know."

Ralph glanced at his brother. The kid seemed to be thinking hard.

"Well," said Alex after a moment, "maybe all killing isn't wrong."

The zookeeper, smiling slightly, nodded.

"But," said Alex, "it feels wrong. Especially if it's someone you know—like Perry. That would be very, very bad."

The zookeeper stroked his forehead and then cast a glance at the ceiling. He seemed to be losing his patience. "Look," he said. "I told you. All paramacia are interchangeable—identical."

"I know twins at school," said Alex. "They look the same, but they're really different."

"That's not what I meant at all." The zookeeper shook his head. "What am I doing, debating with a"—he looked Alex up and down—"debating with a freckle-faced seven-year-old?"

"I'm almost nine."

Glancing at Alex, Ralph saw the tell-tale warning signs: the balled fists, the slight quavering of his lower lip. He looked back at the zookeeper. "Mister," he said. "Stop teasing my brother."

"I'm not teasing him." The zookeeper pointed a finger at Ralph. "And, if I may ask, how old are you?"

"I'm nearly twelve."

"Nearly twelve." The zookeeper smiled—it reminded Ralph of the way his mother smiled when she was thinking about the past. "But you understand what I'm trying to explain to your brother, don't you?"

"No."

The zookeeper sighed. "Well," he said. "When you reach the age of reason, you'll understand." He stood and looked

at Alex. "All right, young man," he said. "Now that you've gotten yourself under control, maybe you boys should go home." He turned and walked toward the door.

Suddenly, Alex banged the desk with his fists. "You are too teasing me," he blurted out.

The zookeeper stopped and pivoted around, surprise showing on his face.

Alex jumped to his feet.

Ralph stood as well and stared at his brother—at the shoulders shaking with fury, at the quivering lower lip, at the red eyes beginning again to tear over—and knew that Alex's apparent recovery had just been the calm between two tantrums.

"All you do is talk," Alex screamed at a pitch high enough to break glass. "You don't care if Perry dies. You don't care about anything. You don't care if the whole world dies. I like Perry. And you're a bad man. You should go to the war and get killed."

Ralph gasped. Dad would never have let Alex talk to an adult that way. Ralph half expected the man to grab Alex, flip him around and slap him on the bottom. But instead, the zookeeper, looking puzzled, returned to the table and sat. With elbows on the table and chin resting on his folded hands, his eyes were level with Alex's.

"Was your father called up for the war?" he said.

Alex, his fury seemingly abated, nodded.

"He died there," said Ralph.

The zookeeper snapped back in his chair. "Oh my god." Then, letting his hands fall to the tabletop, he curled his fingers into fists, making scratching sounds on the wood with his fingernails. He leaned forward. "Recently?"

"Yes," said Ralph in a voice barely audible.

"I'm sorry."

From the man's expression, Ralph believed he really *was* sorry.

The zookeeper looked gently at Alex.

"I think I understand now," he said, very softly.

For a few seconds, nobody spoke. Then the zookeeper stood. He leaned forward, arms straight, palms flat on the table. "You should be very proud of your dad," he said. "He gave his life so that . . . so that . . ." He seemed to be groping for words. But it didn't matter; Alex seemed not to be listening.

"It's wrong to have a game where you kill things," said Alex, his eyes beginning to tear over again.

"What? Oh, you mean the ZoaZap?" The zookeeper pushed himself erect. "It's just a game," he said, but Ralph sensed a lack of conviction in his voice.

Alex sniffled. "It's *not* just a game." He rubbed the back of his hand across his nose. "It's horrible."

The zookeeper stared at Alex for a few seconds, sighed, and then slowly sat. "Yes," he said, almost in a whisper. "It is horrible—very horrible."

Ralph heard a catch in the zookeeper's voice and for an instant, thought the man was himself about to cry.

"I've always hated that . . . that damned game." It looked to Ralph as if he were talking to the table. "But Bright-Spring donated the money for the wing." The zookeeper made a fist. "Poor helpless kids," he said, punctuating his words by tapping his fist against the table. "No control over the events in their lives—as if I had any either. God damn this war."

While the zookeeper muttered, seemingly to himself, Ralph took a quiet, sideways step and put his arm around Alex's shoulder. Then the two boys, moving as one, each took a small step backward toward the door.

But then the zookeeper looked up. He didn't seem angry, but he didn't say anything or even move. He just stared.

The boys stood motionless—waiting.

Then, when Ralph had just about reached the limit of his endurance for being still, the zookeeper stood and looked down at Alex. "So it's the *idea* of killing that troubles you?" His voice

sounded calm. "The casual disregard for life?"

Ralph glanced at Alex. His brother didn't answer or even nod. He seemed hypnotized.

"Yes." The zookeeper nodded. "I think it troubles me as well." He straightened his tie and then strode to the door. "And I can't stay a sheep forever." He looked back at the boys. "You two," he said in a firm voice. "Come with me."

Ralph, still with an arm around Alex, followed the zookeeper out of the office. For an instant, Ralph thought they should just make a run for the exit. They could get away easily. But it felt proper, even good, to follow the directives of a grown man.

They followed the zookeeper back through the Protozoa Tunnel. Alex's eyes stayed locked on the small of the zookeeper's back. He did not look at the animals. The zookeeper walked out of the tunnel, across the main foyer and then into the arcade.

Ralph, with Alex at his side, melted in with the group of kids in the arcade. Safe within the crowd, Ralph watched as the zookeeper marched up to the ZoaZap console—right to the head of the line. "This game's going out of service," he said.

Ralph heard cries of "aw," and "no fair."

"I'm afraid," said the zookeeper, "that this game is closed permanently."

The kids made more complaining noises but gradually drifted off to other games—leaving Ralph and Alex standing there devoid of camouflage.

The zookeeper stepped behind the ZoaZap and then motioned for the boys to join him.

They stood fast, but after the zookeeper motioned again, they complied.

Behind the console, the zookeeper pointed to the power cord, one end of which was plugged into a heavy-duty power socket. "Unplug it," he said to Alex.

Alex wrinkled his nose and looked up at the man.

"Go on," said the zookeeper. "I'm giving you control. Pick up the power cord and pull."

Alex exchanged a glance with Ralph, then stooped and grabbed hold of the industrial-class power cable. He pulled on it, but the plug stayed in its wall socket.

"It's designed to be hard to remove," said the zookeeper. "You'll have to pull harder."

Alex took the cord in two hands and pulled again. But the cord, straight and taut, still carried electricity and the lights on the ZoaZap still blazed.

"Harder," said the zookeeper. "You can do it."

"I can't."

"Yes, you can," said the zookeeper. "Pull."

Alex bit down on his lower lip and then put his full weight, such as it was, against the cord. Still, the ZoaZap hummed with power.

"Again! I know you can do it."

With a squeaky cry of exertion, Alex threw himself against the thick, black cable. The cord snapped free and Alex recoiled backwards. The zookeeper caught him before he could crash into the game machine.

Then, as the display screen of the ZoaZap went dead and the hum of motors faded to silence, Alex began to cry.

"It's all right." The zookeeper tousled the boy's hair. "It's all right," he said again, softly. "Get it out of your system."

Once more, Ralph felt a pang of envy.

That night, when Alex had climbed into the upper bunk, Ralph, in the lower one, leaned over and switched off the light. For almost a year now, they'd each had their own rooms, but last month Alex had asked if he could go back to sleeping in his old bunk. Their mother thought it was a good idea. Ralph made a show of reluctance, but he wasn't fooling anybody—and he knew it. It felt good having Alex back in the upper bunk—the way it was when they were

little kids.

"Ralphy," said Alex from above.

Ralph rolled over onto his back. "What?"

"When will you reach the age of reason?"

"Already have. Mom said so."

"Have I reached the age of reason?"

"No."

"How will I know when I do?"

"I'll tell you." He rolled onto his stomach and buried his face in the pillow.

"Ralphy."

Ralph raised himself on his elbows. "Alex. Go to sleep!" He let himself fall back down onto his pillow.

"I like the zookeeper," said Alex in a distant voice.

Ralph knew he didn't have to answer. It was just his little brother talking himself to sleep.

"Poor parameciums," said Alex. "Why did they have to die? They didn't do anything bad."

Even though the room was still warm from the heat of the day, Ralph snuggled himself deep into the covers. He closed his eyes.

"God bless Mommy . . ." came Alex's voice.

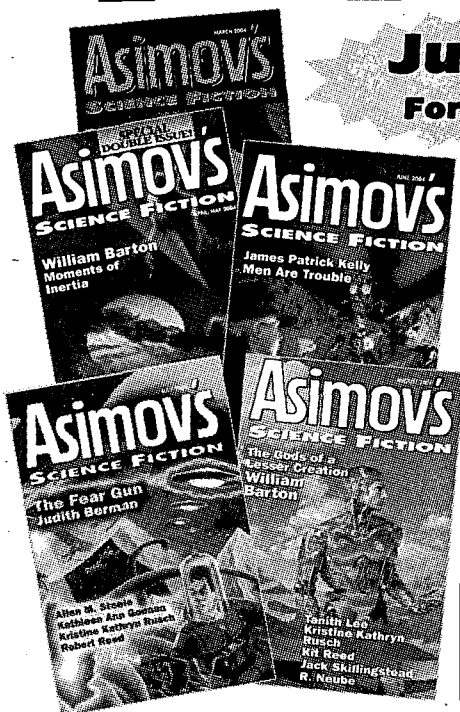
Ralph opened his eyes and wrinkled his nose. That was strange. Alex had given up saying prayers way back when he was seven.

"... and Ralphy. And bless Dad and Perry, and all the other parameciums."

In the darkness, Ralph had a sudden vision; he saw the flashes of bombs exploding, felt the ground tremble as houses collapsed, and sensed the terror in people's screams—in his dad's screams.

He rubbed his eyes and in the dark, could smell the salty moisture on his hands. He rolled over, pressing himself into the cleft between the edge of the mattress and the wall. "And bless all the innocent paramecia," he whispered into the darkness. ■

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The Pain Gun

Gregory Benford

It's easy to be smug about having
The Last Word, but. . .

"We're following the rules of engagement laid down for this theater," the exec officer said.

"Minimize overall casualties, right," I said. "But that increases risk for the men."

"We're to hold this position while negotiations go on," the exec said.

"And on and on and on," I spat back. Nothing like two months in the field to improve your disposition. That, and being on warmed-up field rations. "We take incoming fire and try to minimize casualties, right."

"Hey, that's what we've always—"

I grimaced in the twilight. "We minimize *their* casualties. We used to minimize *ours*."

"Yeah, well, different emphasis." The exec was the kind of officer who used words like that.

I watched the last light leave the bleak streets around us. Desert sunsets

are supposed to be pretty, but this one was coming through the black plume of an oil fire two clicks to the west. It licked at the sky as the last ruby light faded from high cottony clouds. Out here in the Middle East, you watch the sunset and hope you see the sunrise.

Then their AK-47s opened up, blamming away. Mostly just display fire, trying to get us to show where we were. Our guys use silencers with flash suppressors, so they couldn't see our return fire.

My sharpshooter squad was ordered—by me—to keep it clean, precise, silent, just enough to give them wounded. Shoot for the arm, the leg, keep away from the body. Aiming low is best. Not easy to do when they're just a profile in a window, or running in the shadows.

I gave the nod.

So down go the AK-47 guys. Most of them would live, which to me is a

shame, but those were our orders.

They're still spraying slugs everywhere, Jihadi marksmanship. You can hear ricochets humming away into the gathering night. I can see their flashes from the ruined concrete prefab buildings down the street. It's pitch black now, dusk totally gone, and in my infrared goggles I can see they're swarming in the alleys, getting ready for yet another assault. *Allah time*.

"Let's call in some air support," I said.

"No, we got something new coming in." The exec jerked his thumb behind us, sardonic mouth twisted in his idea of postmodern humor. I could hear the *whack-whack* of a chopper landing a few hundred meters back, in the safe zone shielded by the burnt-out husks of apartment buildings.

We were holding the center of the city. It was mostly big, blocky concrete slabs with hollow-eyed windows, the locals long gone. Flypaper city, some smart TV guy had called it. Let the vermin come in, get stuck, swat them. Better than they come after us where we live, is the logic. Not mine, but a logic.

Peacekeeping is like that. Except . . . just who are you keeping the peace for?

"Whatever miracle you got, it better get here fast," I said sourly. I'd been a first louie for five years and if there were any jobs back home worth a damn, I'd never have re-upped . . . but that's history. I'm a soldier now. Trained killer. Only peacekeeping isn't combat.

It was getting into the hard darkness. Some people never learn. They started coming out of the alleys, no prep at all. I picked up my piece—an old-style M-16, 29 rounds in the clip—and got off a few.

So down they go, too. We're a good squad, trying for the wounds, yeah. Okay, maybe I aimed for body center on some of them—they were running fast—but most go down in a spray of

blood and then we let them crawl off. It goes on for about ten minutes and then their nightly show of bravado is over. Honor established. The dead—there are always some—lie out there in the ruby, flare-lit artificial twilight, orange lumps in the pocked street, and it's over. For an hour or two.

We called in a medevac chopper to take out the ones who made it across the street. Wounded and disarmed. They would get a first-class ticket out of this, airborne to the nearest field hospital. Interrogated, maybe held, probably let go.

I envied them, sorta.

A captain came by to do the body count and as usual, shook his head. "You're doin' too many, Lieutenant," he said, mouth tight and twisted. He stood straight and proper. A sniper pinged a round at him, close enough you could hear the buzz like a hornet as it went by, and the captain realized real sudden that he'd had enough. He vanished in a twinkling with barely a nod.

The exec kicked back and offered me a Camel. "Lieutenant, you're not getting it lately."

"You bet."

"The public won't take any more big casualties, is all," he said loftily.

"Well, they aren't here right now taking incoming rounds, are they?" I said, but my heart wasn't in it. Not after two months out here.

Because the exec was right. There had been plenty of nukes lobbed around in the Middle East, millions dead in an afternoon. People were calling it Nuke War II, counting in what was once known as World War II. Iran and North Korea didn't really have cities any more. Or governments to negotiate with. There wasn't a whole lot left of Syria, and Saudi Arabia wasn't looking like much of a tourist spot, either—unless you wanted to see the crater where the Grand Mosque used to be. Whoever threw

that first nuke at the Israelis must not have believed their launch-on-warning policy, even though they had published it. Maybe they weren't the reading sort. The rest was, as they say, history.

History we had to live with.

So, weirdly, now we were trying to keep the peace by *not* killing lots of people. Go figure. I was brooding about this in the dry darkness when the exec said, "Heads up. Here comes the miracle."

Whatever the miracle was, it took four guys to carry it. They put it down in a gray tarp carry-case, unwrapped it—and there stood a big, circular polycarbon disk, sitting on an aluminum box. It had flanges all around and a big bulky power supply that a second team brought up and attached to the side. They clipped some flexible waveguides to it and I got the idea: a microwave generator.

I had worked installing microwave gear for a cell phone company, right out of school. I'd spent more time than I wanted to remember setting up towers, running microwave feeds to antennas, the works. So I recognized the parts as they finished the assembly, using plenty of rectangular waveguides, with flexible ducting linking the parts.

Then a squad of guys came up carrying funny-shaped rifles. These were mounted like standard M-16s, but with a long tube instead of the standard rifle, and a radiating grid antenna on the end. These were rectangular, ending in square mounts. No shell to come out of those rifles. "Whassup?" I asked, but nobody paid any attention to me.

The squad snaked the flexible feeds out of the big miracle machine, and nosed them into the butts of their rifles. There were some barked orders, done in whispers, and the cool night clasped around us all. Most of this job is waiting, waiting, waiting . . . until

here came some more.

Then the carry-grunts went away and two second louies came up behind them. The microwave rifle squad deployed around in the windows of our building. This place had been a school once, but now was mostly bare pocked concrete. Stains on the floor looked like blood or oil and the furniture was smashed into splinters, shoved into corners. *Always a good idea to fight your wars in somebody else's country*, I thought as I watched the squad take up positions. They squinted down their sights and I heard the power supply chug into action.

"We want you men back behind the shield," the senior officer said, a captain coming into view, his chin shiny in the dim light. He looked around like the top dog, eyes penetrating. Maybe he had eaten a burger for lunch and not wiped his face. I decided to think of him as Shiny Chin.

"What's it do?" I asked, already moving back behind some aluminum rolls of foil the grunts were unfolding. It looked like the stuff you wrap around burgers.

They just looked at each other. "How's it work?"

"Watch," one of them said, grinning big and broad. I considered taking a dislike to him.

"They're coming again," the exec said.

I hadn't noticed. Some flashes came from the left, *blam-blam*, rounds winging by overhead.

"Good," one of the second louies said. "Let them."

So we didn't fire. Here came a whole damned wave of shadowy figures, dodging and yelling their high, shrill nonsense, and firing at random. We stood behind the aluminum wall and waited. My hands were itchy and I wanted to get a line of fire, but all I could see was the silvery aluminum. Orders.

Shiny Chin nodded. The power gen-

erator whirred, smooth and steady, and—screams. Screams like you've never heard in your life.

Terror, pain, frenzy. Agony and surprise. Strangled, startled cries. Like their teeth were popping from their gums.

"Stop," Shiny Chin said.

I looked around the edge of the aluminum wall. The funny-rifle squad was not shooting at all. Instead, they swept the street below, aiming some, but keeping their triggers down all the time. *Broadcasting* . . .

Screams. In the street the Jihadi charge broke apart and they melted away, legs pumping.

They were gone. Silence. "Hey," I said. "I like that."

Shiny Chin nodded. "You bet. They won't forget."

"Me neither. How's it work?" The whole thing had been quiet, no noise except the humming generator in the dry night. And the screams.

"It's a microwave beam generator, tuned to a frequency that excites currents in the nerves." Shiny Chin spoke like he was reciting from a manual, which he probably was. He nodded and the generator started up again. "It doesn't actually burn them, no skin damage at all. But it feels like you're on fire."

"Damn," I said. "You tried it?"

"They made us. I couldn't wait to get out of the way."

We stood behind the aluminum foil wall and I couldn't see anything. The generator was still humming. I peered out at the street and they were all gone. Except—one of the bodies there was rolling around, arms lashing out, a low moaning coming from it.

"Turn it off," I said. Shiny Chin did. The body stopped moving.

"That one's not dead." I pointed.

So some medics went out and got him. Maybe my finger itched, but then, I'm old school. The Jihadi types

had faked it plenty of times before, only to set off a grenade or use a knife. But this time the body just lay there.

Shiny Chin looked over the unconscious guy when they brought him up, and had him stripped. Under flashlight he examined the body but there were no signs of damage from the microwaves. The round that blew his left shoulder to pieces was another matter. For that they sent him back to the field hospital. This Jihadi had some tattoos, some Islamic scribbling, and his eyes rolled up white and vacant. A lucky man, considering.

The Jihadi guys came again two hours later. A rocket-propelled grenade appetizer came in, hitting the concrete walls and doing no harm to us. Then the charge, the main dish. Must have been a hundred of them. Yelling, shooting, hitting nothing.

Shiny Chin watched them and gave the signal. The squad started shooting, but again there was no sound but the muted chugging of the power supply. And again came the horrible screams from the street.

"See, you don't have to be a sharp-shooter to hit them with this." Shiny Chin grinned, big teeth. "It's a wave, not a slug. Covers a few meters, gives them a jolt. Keep them in the focus for a few seconds, and they get the message."

"Yeah. Don't be here." I felt like a Neanderthal.

"You bet! The pain quits as soon as they're out of the beam. No damage, so the Geneva Convention board says—"

"No harm, no foul," I recited, remembering high school basketball.

"Dead on!" Shiny Chin was enjoying this, the first field deployment, and from the jumpy excitement in his shiny too-big eyes I knew it was going well. There was a promotion in this, I could smell it. Only I didn't want a promotion, I wanted out. Still . . .

"Sir, we're picking up plenty extra

traffic on their satellite phones," a warrant officer said, coming up and pushing his laptop at Shiny Chin.

"Huh?" I said brilliantly.

"The Jihad Front has plenty of communications capability, y'know."

I blinked, not following. "So they're...?"

"Massing," the warrant officer said. I noticed his name was Perkins, but he didn't look at all like a Perkins sort of guy. "Coming in from all over, looks like."

"Why?" Still not getting it.

"It's a bravery challenge," Shiny Chin said. "We had a briefing about this—the Jihadi mind. Any challenge to their personal courage draws them."

I shook my head. "So that's how they get suicide bombers."

Shiny Chin nodded, enjoying this, like it was some scenario he had seen in class. "But this is better! No death—exactly as it said in U.N. Resolution whatever."

I was still slow. "Um. So they get to be brave, get to show they can stand the pain, but it doesn't kill them."

"You bet," Shiny Chin said. "But we've done many thousands of field trials, and *nobody* can stand against the Pain Gun."

He said it so I could hear the capitals. He went on, "I tried to stay in the beam and I... I couldn't. It's like fire all over you."

"Yeah?" I was still behind the curve, but I went over to one of the gunner squad and bared my arm. "Lemme see."

Shiny Chin looked at me like I was a remedial student, which wasn't far wrong. A long moment, his mouth pressed thin so the lips showed white. Then, slowly... he nodded. The generator started up. The gunner backed off, put the flat muzzle of his rifle a meter from my arm.

"Sure you want to do this?" Shiny Chin asked, voice real whispery.

"Hey, sure," I said, nodded—and

the pain came.

What you can't realize before is that your flesh says, *I'm on fire!* You look down at your arm where the totally invisible beam is landing, and you try to say to yourself, this is just my nerves getting jangled, I can take this—but that doesn't work. No way. The body ignores your convinced mind.

Instead, your body says *I'm on fire!* *I'm on fire!* *I'm on fire!* and that's all it wants to hear.

So you do what the body says. You lunge to the side, sprawling across the floor, anything to get out of the beam and to stop the *I'm on fire!* Just like I did.

Lying there, looking up at the grins the shooter squad tried to hide, and Shiny Chin's twisted mouth, I was just plain happy to be breathing, *whoosh*, in and out, heart hammering and the *I'm on fire!* voice gone.

They let me lie there for a few minutes. I just kept breathing, *whoosh*, *whoosh*, happy to be alive and not thinking about anything except of course that I had made a complete fool of myself, but then, *whoosh*, *whoosh*, *whoosh*, breathing—a miracle!—I was still alive. An intense whole moment, all mine, and I knew that something had changed in the world. My world.

Pain can do that to you, I realized. They brought me a thermos of coffee and I sat to the side and we all waited.

After an hour it looked like the show was over. So we set watches and I got some sleep.

Up the next morning, all quiet. Field breakfast, those self-warming little dishes that never go bad, only the food tastes like cardboard with ketchup on it.

But for me it was time to savor the revelation. Not that I could be hurt, hurt bad, and stand it. Something better—that the pain cleared my mind. I could think better. I could feel the dry,

dusty heat, taste the buds of flavor bursting in my mouth from the coffee—even Army coffee!—and feel the world wrapping its warm self around me. The pain had brought the whole world flooding into me. Not that I had liked it, no. I never again wanted to feel that sensation of frying skin, searing into me—never. But the aftereffect somehow made me think fast and crisp and better.

And here they came again.

We had warning, so Shiny Chin redeployed his guys and we followed to protect them. “Looks like it’s the other way around,” I said to my guys, as we fell back in order.

In usual combat, movement with cover means the grunts go first, providing covering fire. This time, though, we carried out a flanking maneuver down a side alley, and Humvees and jeeps covered us. In the lead, Shiny Chin set up the generator and some of his microwave marksmen. They swept the whole area ahead, into windows and doorways, holding their pulses long enough to bring the occasional frightened cry from deep in the innards. We moved slowly, ready for the usual random shots, but nothing came.

Shiny Chin waved me into the lead Humvee. I climbed in the back and we ran a quick, fast sally across the main boulevard. His men were spraying microwaves down that street and we could see figures running away, several hundred meters away.

“How strong is that stuff you’re shooting with?” I asked, my M-16 hanging out the window, just in case.

“Few tens of kilowatts.” Shiny Chin squinted everywhere, calling out uncovered angles to his men. The silence was unnerving, until we heard the occasional distant scream. The men laughed then, grinning. This was a hell of a lot better than shooting people.

“That’s not the big thing, though,” Shiny Chin said. “This gear uses a high

frequency, which means small wavelengths—hey, over there—” He pointed and his men sent a silent volley into a warehouse we were zooming by. Two screams, then we were gone.

“What frequency?”

“Pretty high,” Shiny Chin said, eyes darting over the windows and doors as we flew by them.

I tried to remember my cell phone work. The phones used wavelengths as long as my forearm, I recalled, and those could bounce around inside buildings. That’s why steel girders don’t stop them—the waves just wrap around the metal skeleton and keep going. Concrete hardly diminishes them at all. You can sit inside anything short of a steel box—say, an elevator—and still use your phone.

“The wavelengths are so small,” Shiny Chin went on, “they can snake in through even little cracks. So nobody’s really safe.”

“Why’d we stand behind those aluminum walls, then?”

“We weren’t shooting at you, so one screen was enough.”

“Won’t they figure that out? If all it takes is foil wrap—”

He chuckled, showing the big teeth again. “Wear an aluminum suit, fine—only how do you see out? And without even an air vent, how long will you last?”

“You talk like you tried it.”

“Saw it tried. The guy couldn’t even find his way around. A big shiny target.”

We slammed to a stop and the whole convoy came hauling in. The microwave team swept the area, got no screams, so we went into a big ten-story building. There was plenty of wrecked furniture and some big shiny new garbage cans on the first floor. No civilians around, of course. A corpse on the second floor, maybe a woman. The upper levels were a mess, some of it burned and foul-smelling. From the fifth floor we com-

manded a view of a city square. A big fountain in the center of the square was filthy, and the roads around cratered by mortar fire. Out in the distance was a moonscape of gas fires and hollow-eyed buildings. I looked at the fountain and saw scrape marks in it, where people had scooped up the last of the water and left marks in the thick brown algae that had been growing at the bottom. Now it was dry and sand drifts lapped against the white marble troughs.

We deployed across the fifth floor, getting good lines of fire down the six avenues that converged on the square. It was late afternoon and in the slanting sunlight there were plenty of shadows to hide in, both for them and for us.

"Plenty satellite phone traffic," a comm guy said.

I sat and drank some water and ate an energy bar and thought a while. Remembering installing repeater stations for the cell phone towers, antenna designs, old times. Letting pictures build in my mind.

"You're trying to cover a pretty big area, aren't you?" I asked Shiny Chin, looking out over the big square.

"Yeah, we'll have to be good." Choppers were buzzing around in sweep circles.

Pretty soon we got calls saying teams of the Jihadis were moving up, filtering through the wiped-out buildings leading toward us. We called for number estimates and the choppers said probably hundreds.

"If they come at us in a rush, we're not going to be able to just use this pain gun of yours," I said, straight and not too diplomatic.

"Yeah, 'fraid not." Shiny Chin sucked on his teeth and thought. "So your guys can shoot when they want, I guess."

"I got an idea, though," I said. "Maybe we can use your gear to make a kind of . . . perimeter."

Shiny Chin looked puzzled. "How you mean?"

So I told him and he shook his head. "They would've thought of that, and if it worked, we'd have it right now."

"Not necessarily, sir."

"I'd have to check with division, the tech specs people, it would take—"

"Let me put something together. Just for a trial."

Shiny Chin didn't say anything. I took that as a silent yes, and got to work.

I went down to the first floor with a squad and found the garbage cans. They still had their lids, nice and clean and with the delivery labels still stuck on. We carried them back up and I walked over to Shiny Chin with them. I told him again and he looked at the lids and shook his head. "Give me an extra feed, then." I drew him a sketch, showed how I'd hook the system up. "I'll need some flexible waveguide, maybe ten meters of it."

"We're spread a little thin up here—"

"I'll hook it up over on that corner—" I gestured toward a sheet wall that was solid concrete. Beyond it was a broad area of the square. The way the windows nearby were angled, they didn't command the whole square. The Jihadis could cross there. A classic problem, incomplete field of fire. You can look it up.

Shiny Chin looked skeptical, his eyes penetrating again. So I said, "I know how to shape the lids into a crude horn. Used to work in microwave tech. The beam, it'll cover a broad angle, cutting off that approach from the left." I pointed and gestured as a popping sound came from far off. A round winged up and smacked into the concrete a few meters away. "Looks like they're getting going."

Shiny Chin nodded and walked away. Saying nothing was the best way to let me go ahead and still be able to say afterward that you hadn't given

any such orders. We both knew that. Good ol' plausible deniability—where would the world be without it?

So I set to work with my squad. We punched holes in the lids for the flexible waveguide feeds. Wrapped those connections in extra aluminum foil that Shiny Chin's guys had brought. Crinkled it on tight. Next, I carefully bent the aluminum can lids into a half-disk sandwich, just by folding them over. Then I built up a flower-like affair, figuring to make it act like a focusing reflector. When it was done, there was more AK-47 fire coming in, but the Jihadis weren't ready to rush us yet. They liked to shout and shoot and show off a while first.

"They're waiting for sunset," Shiny Chin said, coming by to look at our handiwork. "Most of the square will be in shadow."

I just nodded, concentrating. My eye tried to trace out the way the microwave beam would go, fanning out in a disk. Okay, done. Now the hard part.

I put on my field vest and helmet, fastened the straps good and tight. I lined my men up and said, "I'm going to hang out this window, anchor this little aluminum flower to the window sill with a bolt. Maybe take a minute."

They looked skeptical and my sergeant said, "You're gonna be awful exposed out there."

"That's why you're going to be giving me covering fire," I said, and picked up the aluminum blossom, my creation, looking like mostly a bundle of shiny scrap. With the flexible feed, maybe a big dead aluminum rat.

It seemed to take a long time. I hustled the gizmo into position and could feel the seconds ticking by like a long, bad dream.

As I got back in, *whang!*—a round slammed into my helmet and I fell. My ears were ringing as I got back up. A big dent in the helmet, too.

But when I looked out, there it was,

now looking like a big-lipped silver frog perched on the windowsill. Squatting in the last of the sunlight, it glowed orange and ruby red. I looked out over the ruined city toward the desert and thought that this could be a pretty country, except of course for the people in it.

Maybe I'd stirred them up. They came at us pretty quick, yelling and firing.

I used hand signals to tell my rifle squad to hold their fire. Let them come.

I had positioned my men in a firing crescent. I stood next to the window, watching the square in a mirror. My sergeant had gotten that out of a fancy bathroom; it even had a gilt frame. In it I could see the Jihadis come sprinting out from the shadows. They never seemed to run out of ammo, but most of it went up into the sky. Maybe they thought they'd get credit in Paradise for effort alone, not results.

They had sized up the situation about the same as we did. So here they came—hundreds, trying a mass attack on the theory that we couldn't shoot that fast.

Shiny Chin gave the signal to his shooters. The generators hummed.

The eerie thing about the microwave rifles was their silence. The man pulled triggers and nothing seemed to happen. I could see the Jihadis looking a little puzzled as they dodged and darted. No return fire from us. Plenty of them were screaming and bolting, though. They had hundreds of meters to cross and some looked around, wondering why their comrades across the square were suddenly crying out, turning and running away. Since they couldn't see hear any return fire, couldn't see the beams that were hitting them, it clearly rattled them.

The ones closest to us slowed a bit, maybe wondering if they were running into a trap. That filled the square

even more.

I turned on the power lead to my contraption.

I had waited until a lot of them were clustered in the wedge of the square where the broad beam should strike. That made it a good experiment. Let the targets cluster, then try the effect all at once.

A chorus of screams. Where the beam struck, within seconds, men's eyes widened, their mouths jerked back in a rictus of pain, and the sounds rushed out of their chests.

Only for seconds. Then they all turned and ran, scrabbling for safety. In ten seconds that entire section of the square was deserted. Those who turned and ran told me the pattern of the microwaves my gizmo radiated.

Then came a silence so profound I could hear the breeze sighing in the vacant rooms and windows. They were gone.

"Plenty talk on their phones," a sergeant said to me in passing.

But no movement.

I walked over to the windows that looked down on this building's inner courtyard. The battalion HQ was there, officers looking up at me. I used my short-range comm to tell them and they nodded. I noticed they had a captured Jihadi, a big tall guy with a purple turban wrapped around his head. I asked about him and in reply a major said he and two others had been trying to sneak in behind us, carrying RPGs to get the Humvees. The other two were dead. There hadn't been time to use the microwaves on them, not when they were that close.

The long, lean Jihadi was already trussed with hands behind and looked scared, eyes showing a lot of white. He was sitting at the base of a blasted statue and pretty soon they marched him into the building below.

I ate another energy bar, drank some tepid water, and thought. The contraption had worked a lot better

than it had any right to do. There were plenty of situations in this world where a small force had to contend with large, angry crowds. Riots, protests, civil disobedience. A fan-antenna like the one I'd rigged could sweep an area clean with just a few seconds of these microwaves. No more one-on-one, not even any marksmanship—just blanket everything within sight. And nobody gets wounded.

In the eternal pendulum swing of power between what I think of as Tribes Against the Empire, also known as Underdeveloped against the Developed, here was a new idea.

Maybe it would do some good. Better than killing people, at least.

The minimize-casualties orders we were working under had irritated me, sure. My men had taken a few hits over the last few weeks, trying to comply.

But here was a way to do it without running risks. The old-style crowd-control methods, like tear gas and fire hoses, could hurt people and sure weren't much good against armed gangs anyway. These spooky microwaves were a big plus.

"Y'know," I said to Shiny Chin, "if you had the chance to put some metal sheets up, out along the our lines of fire . . ." I tried to envision tin roofs ripped off the sheds around here, and lined up along the approaching streets. "That would funnel the waves, concentrate them more on where the enemy was gonna come."

Shiny Chin frowned. "I don't follow."

"Like mirrors," I said.

Shiny Chin squinted at me. "You might talk to division about that."

From his look I could tell he was figuring how this success might help him up the ladder. So naturally, he reasoned that I was thinking the same.

I had to admit, it was an interesting technical trick. *Pain rays*, the tabloids

would say. Using them to avoid deaths had a good feel, all right. The kinder, gentler Army.

I'd been planning to quit when my enlistment ran out. But this made me rethink . . .

Then I wondered how long it would be before the Jihadis got this technology. Years, I hoped. Shiny Chin had been cagey about telling me what exact frequency these things used, and maybe that was crucial.

But it would be only years, not decades. Unless we figured out how to keep ahead of the enemy, who didn't care about our deaths at all. And maybe even theirs.

From below I heard a scream. It carried that same high-pitched, startled sound I was getting used to.

The tall Jihadi, I was pretty sure. It hadn't taken long to figure out that this new wrinkle was useful for torture, too. Another swing of the pendulum.

All advantages were temporary; look at Nuke War II. Maybe the best you could do was just use the time the advantage gave you to get something done. Bask in the moment. It wouldn't last. I thought about that some and then went to watch the glowing ruby sunset. ■

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Climbing the Blue

A Tale of Old Earth

Stephen Baxter

The same circumstances can produce overwhelming problems and exhilarating opportunities in bizarrely entangled combinations.

(Note: this story is set a few centuries after the events of "PeriAndry's Quest", Analog, June 2004.)

"Everything about our world is *made*," said the Natural Philosopher. "Made by intelligence, perhaps even built by human hands! Tonight I will prove it to you—prove it, at least, to those with minds flexible enough to understand..."

To Celi, to any Foron, such thoughts were radical, shocking. But Celi was electrified.

Celi had only taken Vala to the lecture that night because he had heard rumors that the Philosopher was going to cut up a body. A *human* body, sliced apart in Foro's own town hall! It was a sight no self-respecting sixteen-year-old could miss.

Celi's father, Sool, had given his per-

mission in his usual absent way. After all, he was going too. But his mother had seen right through him, as always. Pili was kneading bread, her powerful arms coated in flour. "You're going because you think it will be some kind of circus. Blood and bone and guts."

Immersed in rich kitchen smells, Celi squirmed, ashamed. "Mother, it's not like that—"

"She's a bad influence, you know."

"Who?"

"Vala. Her Effigy has yours by the throat, doesn't it? And she has you climbing the blue at a snap of her fingers."

Climbing the blue. On Old Earth, time was layered: the higher you climbed, up towards the blueshifted sky, the faster time passed. So, said the more serious citizens of Foro, if you burned up your life on nonsense, you were climbing the blue.

Celi didn't know what to say.

Pili sighed, and cuffed his head gently. "Go, go. But if you only have eyes for Vala, at least keep your ears open. You might learn something, and then the evening won't be a total waste. But get the flour out of your hair first."

So off he had set, at a run, to Vala's house.

And as it happened he did learn something that night: something about the world he lived in, and about himself.

HuroEldon, Natural Philosopher, stalked back and forth over the stage in his richly woven robe, casting flickering shadows by the light of the torches on the walls.

The setting was magnificent. The town hall was a domed chamber, big enough to hold all Foro's adult citizens. It was actually a wing of a palace, ruined in the Formidable Carress. Now it had been rebuilt, and not as the home of a ruler, but as a meeting place for all Forons, rich and poor.

But even here HuroEldon's voice resounded like Lowland thunder, Celi thought, a voice too large to be contained by mere stone. The Philosopher had about him a rich whiff of antiquity: it was a strange thought that though Huro looked no older than fifty, he might have been born centuries ago.

And as he made his prefatory remarks, on the stage beside Huro were two bodies, corpses strapped to tables, covered by dust sheets and attended by assistants. Celi felt deeply queasy.

"The world is a made thing," Huro said again. "An extraordinary claim that requires extraordinary evidence—and I have it!" With a showman's flourish he drew a long knife from his sleeve, and his assistants pulled the cover sheets from the tables.

The audience gasped. One revealed corpse was of a young spindling, its

six legs splayed, its long neck limp as string. And the other corpse was of a little girl.

Celi felt Vala's hand creep into his own. He had actually known the child; she had been called Bera, and she had died of the Blight, aged only eight. Celi could see the disfiguring burn-like stains on her skin. Celi was ashamed at his earlier grisly curiosity: it made a big difference when you knew *who* was to be cut up.

HuroEldon held up his knife, inspecting the blade. Then with a butcher's casual expertise, he slit the girl's pale body from throat to pelvis and emptied its chest cavity of organs. There was a smell of sour chemistry; the body's blood seemed to have been dried to a powder, and the organs were shriveled, like blackened fruit. But still people groaned, and a few stumbled out of the hall, their hands pressed to their mouths.

Huro displayed the essentials of Bera's bone structure, the long spine, the ribs, the limbs attached by ball-and-socket joints. "Thus the architecture of a human," he said. "And if you were to dissect a rat or a bird you would find much the same body plan—adjusted for the purpose of running or flying, of course, but displaying an essential unity of design." Despite his revulsion, Celi was fascinated by this brisk lesson in skeletal anatomy.

Huro turned his back on the girl and stalked to the other table. "A spindling, though, is quite different. Why, you can see it even before I open it up. Look at it! *Six legs*. Six limbs, not four! And if we look deeper, we will find more divergences . . ."

Efficiently he peeled back skin and prized out bones from the spindling's once-elegant long neck—except that these grayish objects weren't actually bones. "The spindling has an inner skeletal structure. That much we have in common with it. But look—can you

see?" He stalked around the front rows of the audience, who flinched back from his gory specimens. "This isn't bone. It's a kind of cartilage, quite unlike the human design."

He tore apart the spindling, displaying more features of the animal. For instance, a human's digestive system was essentially a duct that passed through the body: food in one end, waste the other. A spindling had a closed loop, so it used its mouth as its anus, for food and for waste. Celi was struck by this observation. Everybody knew to keep out of the way of a spindling when it prepared to vomit up its shit, but it had never occurred to him before how different it was to the human way of doing things. He felt curiosity stir; he wondered how many other strange features of the world were waiting for him to notice them, if only he could learn how to look.

"What does all this mean?" Huro demanded. "It means that the spindling does not come from the same tree of life as humans and rats and birds. The spindling has been *brought* here, to this world of ours, from somewhere else—or else we have been brought to *its* world, although that seems less likely as there are more creatures like us than like it. And the spindling is not the only example of an alien among us, among the plants and the animals.

"Like most primitive cultures on the Shelf, you Forons cling to a naïve naturalism! You believe that the world as we experience it emerged from the blind operation of natural laws, that intelligence had no hand in it. But *that cannot be true*. The spindling is *proof* that the world could not have developed organically; one counter-example is enough to demonstrate that nature lacks the necessary unity for that to be so. The simplest hypothesis is in fact that it has *all* been made, all shaped by intelligence, from blueshifted sky to redshifted Lowland." He held up spindling cartilage, and a hip

joint from poor Bera. "Here is the proof!" And he threw the bones to the floor.

There was a long silence. Then one man rose to his feet. Celi was moved to see that it was his own father. Sool was a proud Foron clearly who bristled over Huro's comments about primitivism and naivety. He demanded to know if this "radical creationism" was the only philosophical choice. Must Forons now accept gods and devils? Must they cower from storms like their ancestors, and worship the light that flared across the Lowland? Was not Huro's presumption of a higher intelligence actually the more intellectually primitive point of view? He spoke well, a dignified anger deepening his voice, and his neighbors applauded.

But Huro was able to counter him point by point. Despite himself, Celi found himself accepting the Philosopher's arguments. He felt deeply disturbed at the way this arrogant man dismissed his father, and had so easily upset his own worldview.

On impulse Celi stood up himself.

His father, surprised, yielded the floor. As he became the focus of the packed hall—the Mayor herself was here—Celi quailed. But he held his nerve, and dramatically pointed at Bera's corpse. "Philosopher, if you can tell us the design of the whole world, why could you not save *her* from the Blight?"

Huro smiled. "If you ask such a question, young man, perhaps you have it in you to become a doctor, so you can answer it yourself. Talk to me later." He turned away to take more questions.

As Celi sat down, stunned, Vala tugged his sleeve. "You won't go to that awful man, will you?"

"No," said Celi immediately. "No, of course not." But as he stared into Vala's wide blue eyes, he knew he was lying.

Foro was situated on the side of a cliff, on a broad plain called the Shelf. The Forons were proud of their town, for they had built it with their own hands. But it was cupped in the mighty ruins of a much older city, devastated generations ago by the Formidable Caress.

And if you climbed the rocky walls above and below the Shelf, you climbed into stratified time. You could ascend into a rarefied air where time raced like a pumping heart, or go down into the grave torpor of redshift.

In practice nobody from Foro ever did climb the rocks. It just wasn't practical to run your life with time's cogwheels slipping constantly. And the Forons' reluctance was cultural too. Celi's people were proudly descended from a group who had been kept in an up-cliff community called the Attic, where their lives had been burned up in the service of slower-living rich folk on the Shelf below. Celi was the great-grandson of rebels against that strange enslavement.

But if the folk of Foro ignored the stratification of time, the Philosophers, like HuroEldon, exploited it.

The Philosophers marketed knowledge. In their own community far down the slope, their lives, slowed by time, were stretched out. The Philosophers devoted their extended existences to recovering some of the wisdom that had been lost during the Caress, through study and patient archaeology. And they made their living by selling that learning back to those who had lost it. Thus HuroEldon had ascended grandly from his redshifted keep to instruct the people of Foro on how to turn their growing town from a heaped-up clutter into a functioning city with common services like water supplies, how to reclaim the ancient canal system to irrigate their fields, and so on; he could then step forward across time to advise on such projects

as they were carried out.

Celi came to realize that this gift of knowledge was essential. It was only a few generations since Forons had begun to grope their way out of the fog of fearful superstition that had been the legacy of civilization's fall in the Formidable Caress. And it was even less time since the deeper psychological shock of that fall had begun to fade: the edge of the Shelf was still lined by the remains of funeral pyres, where the citizens of Foro, despairing of a future in which another Caress must inevitably shatter all they had built, had burned all their learning with them when they died.

But however useful his advice, for Forons, who prided themselves on their egalitarian instincts, it was hard to stomach Huro's arrogance. That lecture on creationism had been a gift by Huro, rich with too much knowledge, a bauble tossed carelessly away by a man come to advise on sewage.

And Huro deflected Celi's young life just as casually.

In the end Celi did speak to the Natural Philosopher after the lecture. And within days he was assigned to Dela, the town's physician, to begin his apprenticeship as a doctor. It all happened so quickly, his whole life diverted. When he thought this over Celi found he resented it, but he knew he would not take one step off the path he had chosen—or rather, that the Philosopher had chosen for him.

But when HuroEldon called on him, long after that fateful night in the town hall, Celi found it hard to hide his nervousness.

HuroEldon walked grandly through Celi's study. In his Philosopher's cloak, Huro was magnificent in this shabby background. He inspected Celi's notes, carefully scraped onto spinning-skin parchment, and pored over an area he called Celi's "laboratory," an array of herbs, fluids, and minerals

labeled and annotated.

Five years had worn away. Celi, now twenty-one, was growing into his role in the town, as a practicing physician—and as husband to Vala, and expectant father of her first baby. But for HuroEldon, who had returned to his redshifted community of Philosophers, less than a year had passed.

"I'm grateful that you called on me," Celi said stiffly.

"I wanted to see how the town's bright-eyed young doctor is progressing. It is always amusing to skip forward in time, so to speak, and see how such stories as yours have played out."

"I'm not a doctor yet," Celi said. "I'm still learning."

"That will never cease, I hope."

"And Dela is still working—"

"That old witch! Oh, Dela has the charm; she knows the right words to murmur when Effigies go spiraling up from the dying. But you have something far more important than that." Huro tapped Celi's temple. "A mind, my boy. That and your spirit, your doggedness. I saw it in you even during that night in the town hall."

"I'm surprised you remember it . . ." But for Huro it wasn't long ago at all. "Your lecture made a great impression on me."

"Obviously," Huro said dismissively.

"It wasn't you showing off your knowledge that intrigued me," Celi said, irritated. "It was Bera."

"Who?—oh, the little girl on the butcher's slab. What use is all the knowledge in the world, you asked, if it can't save a child from the Blight?" He waved a hand at Celi's homemade laboratory. "I can see you've devoted yourself to the cause. But the Blight won't be wrestled into submission, will it?"

No, it wouldn't. That was why Celi had asked to see HuroEldon.

Celi was already a competent physician. He could deliver babies, stitch

up wounds, set broken limbs, and comfort the dying, and he had acquired basic knowledge of the vectors of infection, of antisepsis and antibiotics. Much of this learning, preserved and sold by the Philosophers, was rumored to be very old.

But Celi had also learned that there was nothing anybody could do about the Blight.

It showed up as a skin discoloration first, like a burn. This stage could last a year, even more. But eventually it got into your lungs, and within three days you were dead. None of Dela's medicines could fight it; it was only rigid quarantine procedures that kept it from overwhelming the community altogether.

What frustrated Celi was that he was sure a cure for the Blight was achievable. As he had visited case after case, Celi made notes of the folk medicines he encountered, concocted from animal blood, plant roots and seeds, mineral salts—potions and salves born out of desperation. The surprising thing was that some of these remedies showed signs of slowing the disease. Somewhere in all these ingredients was a cure, he became convinced.

But finding that cure was a tremendous problem. There were no full-time scientists here; Foro wasn't rich enough to afford them. And a little systematic thought demonstrated that there were simply too many combinations of ingredients and relative concentrations to be tested in less than a lifetime, even if he were to dedicate himself to the project full time—which, as he was one of Foro's-only two doctors, was quite impossible.

And now HuroEldon, who he had hoped would be a source of old wisdom on the Blight, dismissively told him it was all a waste of time anyhow. "We live in a world in which time is stratified, remember. Time flows faster the higher you go—"

"I understand that," Celi said testily. "Do you? That's impressive. *I* don't. And you must also understand, my boy, that organisms change—especially the pesky little brutes that bring us diseases. The Blight can transmit itself through blood, or spittle, or through the air. Whatever we do, a subset of the Blight's disease vectors can always waft up into the blue where, accelerated in time, they can mutate, faster than we can hope to match them with our remedies. You see? It's thus a fundamental feature of our world that disease is always beyond our control." He shrugged massive shoulders. "One must simply accept the losses."

Celi could not fault the Philosopher's logic. But on some level, he saw, Huro simply did not *care* that it was impossible to defeat the Blight. Perhaps this was a legacy of the past. HuroEldon's very name was a relic of the complicated compound nomenclature once adopted by the aristocracy of Foro, while Celi's was a blunt Attic name. Even generations after the rebellion, in Huro's heart he still thought he was better than Celi, and the swarming townspeople he tended. Celi kept such thoughts to himself.

Huro seemed to be growing bored. "You're wasting your time here, you know. There are much more intriguing questions for a mind like yours to address."

"Such as?"

"Such as the subject of that lecture of mine: the indisputable fact that the whole of our world is a made thing, or at least assembled from disparate components, from blue to red, top to bottom. We've plenty of evidence beyond spindling skeletons. Why, we believe that the very stratification of time is an artifact."

Celi walked to the window and peered up at the sky. The light of Old Earth came from the shifting glow of the Lowland, reflected from the clouds; through those clouds Celi

could see stars wheeling by, sharply blueshifted. "Why would anybody *make* all this?"

"Think it through," Huro said. "If you could climb down from the stars, down into this redshifted pit we call our world, you would be preserved, locked in time, while the stars wheeled and died over your head."

"Preserved?"

"We believe that once Earth was a world without this layering of time, a world like many others, perhaps, hanging among the stars. And its people were more or less like us. But Earth came under some kind of threat. And so, to protect their children, the elders of Earth pulled a blanket of time over their world and packed it off to the future. You must understand this is a rather flimsy hypothesis, and as I always say myself, extraordinary claims require extraordinary proof, and we don't have it yet! But it's the best justification we've come up with yet: Earth is a jar of time, stopped up to preserve its children."

Celi frowned. "But then, what about the Effigies?" The ghostly forms released by the dying represented the biggest single mystery he had encountered as a doctor. "Are they *us*—are they human souls, leaving a dying body? And if so, why do so few of us release them on death? And why should the world periodically shake itself to pieces in the Formidable Carresses?"

"Good questions. I wish I had good answers! Perhaps you will find out for yourself—when you come down into the red and join us."

So here was the invitation, bluntly stated. Celi said, "I am a doctor. I have patients here in Foro."

"They will die in the end, whatever you do. *While you could live on.*"

"I have a wife. Vala. She is carrying our first child—"

"The blue-eyes who was with you the night of the lecture? How cute.

ANALOG

Bring her with you. Or, better still, leave her behind." He leaned closer, and Celi smelled gin on his breath. "Stride into the future with me, five years, ten, twenty. There will always be more girls, not even conceived yet, fresh fruit waiting to be plucked. How do you think I keep myself entertained during these visits to your dismal little town? It isn't all sewage and creationism, you know."

The curiosity Huro had woken in Celi that night five years ago would never leave him. But everything else about Huro and his proposal repelled Celi, everything but the allure of knowledge. It was easy for him to turn down Huro's invitation.

But as it turned out, Celi's future was after all decided that day. When he returned home, he found Vala sitting alone, stroking her belly, her face streaked by desolate tears. A pale pink stain, like a burn, was spreading across her cheek: it was the Blight.

Her life and his had been destroyed, he thought, by a vector of infection he couldn't even see, and which he would never have the time to defeat. He couldn't bear it.

It took a sleepless night of calculation for Celi to decide what he must do. He would not follow HuroEldon into the red. He must climb up into the blue, alone.

In the morning he packed quickly: a few clothes, some dried food, bags of seeds and roots, a set of his medicinal samples. Then, with his pack on his back, and a cage of mice dangling awkwardly from his belt, Celi walked out of Foro.

He made for the cliff face, and began to climb. Once there had been an elevator system here, worked by tethered spindlings. Now you had to walk. But a whole series of staircases bit into the face of the rock, heavily eroded by usage and weathering. He was winded by the time he had climbed the nine

hundred steps to what remained of the Attic, where once his ancestors had toiled.

He walked around curiously; he had never been up here before. There was nothing left but post-holes in the ground, the scorch-marks of abandoned hearths, and gaunt caves in the cliff walls that had once been used as kitchens and dormitories. It all looked much older than the two or three generations since its abandonment, but that was in Foro time; up here in the blue this place had grown much older than the Forons' memories of it.

He dangled his legs over the edge of the cliff, sipped water from a spring, and looked down into the depths of the Lowland, an ocean of misty red-shift. From here, Foro too was bathed in a crimson glow; he could see the people and their spindling-drawn vehicles crawling as if through syrup. Already he was cut off from his family, from his patients, from Vala, by the streaming of time. He wondered how many of them he would see again.

Once he had made his decision to leave he had been determined to keep his plan secret from everybody—even from Vala. Perhaps it had been the kindest thing to do; or perhaps he had feared his own determination might waver if he hesitated.

But Dela, the doctor who had tutored him, had seemed to have an idea what he was up to. "It's the white mice," she told him.

"What about them?"

"Mice can catch the Blight, like humans. Spindlings, for instance, can't. And that's important to you, isn't it?"

"I don't know what you're talking about."

Unexpectedly she hugged him. Old enough to be his mother, she was a nurturing doctor, but not given to physical displays of affection. "I will miss you. You're a good colleague."

"I'll be back in a few days."

"Of course you will."

His father had accepted his bland assurances that he would return. He had a more strained encounter with his mother, who, with her usual acuity, guessed he was up to something. "I always did say that girl would have you climbing the blue."

"Look after her, Mother."

"I will." He embraced her; she smelled of warm bread.

And then had come his parting from Vala. He had left her, and his unborn child, with lies. Now, as he looked down into the layers of time that trapped her, he couldn't bear even to think about it. Wearily he collected his kit and continued the climb.

Above the Attic he plodded steadily along the trails of migrant animals, and when the trails petered out, scrambled over rocks. There were no more people or animals, but he saw the flash of wings, and occasionally heard an echoing caw. He was not alone, not while the birds flew with him.

After a time he noticed a change in the rock. Shattered by frost or heat, its surfaces scarred by lichen, it seemed much more sharply eroded than the cliff faces down by Foro. The stratification of time must be having a profound effect on the very fabric of the world, with higher rock sections eroding away much more rapidly than lower. When he paused to sleep, wrapped in a skin blanket on a narrow ledge, he scratched a note about this in his spindling-skin journal, the first note he had made there.

On the third day he climbed a narrow pinnacle, heading up to a summit. By now it seemed that only he existed in a normal stream of time; he was alone in the clean, thin air, sandwiched between the wheeling stars over his head and the crimson glow beneath.

The slope leveled out, and he stood on a smooth, worn plateau. There was life here: tufts of grass, low trees that clung to the rock face, even a couple

of abandoned birds' nests. Food and water: he could live here, then. But Foro and the Shelf, far beneath him, were lost with the Lowland in a dank sea of redshift. Perhaps there were higher mountains to climb. But surely he had come high enough to achieve the temporal advantage he sought, high enough to defeat the evolutionary enthusiasm of the Blight vectors—high enough to give him the time he needed to save Vala. This would do.

But now that he had stopped moving, doubt plagued him. Could he really bear to lose himself in time like this?

Better not to think about it. Better to begin work; once his patient methodology gathered momentum his soul would be filled with the work, and his purpose. Grimly he began to unload his kit.

Celi stood in the doorway of the home he had built with Vala. He looked round at the walls of mud and plaster, the furniture they had made and bought, the carving with their names over the door. All of it was a lifetime old, yet as fresh as a morning. And there was no place for him, he knew.

He felt an odd stab of nostalgia for his mountaintop refuge, the hut he had built, the cages for the mice. But even if he could climb back up there it would all be gone, weathered away by accelerated time. The core of his life had been hollowed out; he felt as if he had been away only a moment, that he had been aged in a heartbeat.

Vala walked into the room, humming, a towel around her hair. For a moment she did not see him, and he watched her, his breath catching in his throat. It hurt him to see what the Blight had done to her: a crimson stain had spread up from her neck across her once-pretty face. Yet he was relieved that he had, after all, returned in time to save her.

Then she saw him. She recognized

him immediately, and her blue eyes widened. It was unbearable to have her look at what he had become, with his white hair, his stooped back.

He longed to hold her, but time stood between them like stone. Only a year had passed for her, while more than forty had worn away for him.

"You said you would be gone a few days," she said. "Some 'few days.'"

"I'm sorry," he said. "Vala, the baby—"

"You have a son, Celi. A son. Four months old."

He tried to take that in. His leathery old heart beat faster. He held up his precious vial. "Take this. It is—"

"I know what it is. Your mother guessed what you must be doing. So did Dela. Oh, you fool! What use is saving me if I had to lose you in the process?"

He pressed the vial into her hand. "Take it to Dela," he whispered. "She will know what to do. Hurry now. It's what all this has been about, after all."

She bit her lip, and ran out of the door.

And HuroEldon walked in, his robe sweeping. "Well, well. Somebody told me they saw you come staggering back down out of the blue."

Celi straightened. "Philosopher."

Huro leaned closer. "You smell like a spindling's breath. And what is this you're wearing, mouse fur? I take it you found your cure."

"Oh, yes." And the Blight, once cut off from its human host and eliminated, could never be resurrected, even by stratified time.

"I knew you would do it," Huro said grudgingly. "But I never thought you would reduce yourself to this in the process. And you ran out on your patients, despite the vows you doctors take."

"I came back—"

"But what use are you now, like this?" He inspected Celi, as if he were a curious specimen. "Your wife can't

love you again, you know. We humans don't seem to have evolved to handle such differential shifts in time. That's another point that convinces me this is a made world, by the way, that we are designed for a different environment. . . ." He idly picked up Celi's notebook, and paused at the very first note Celi had made so long ago, about the effects of differential weathering rates. "An acute bit of geology. I told you, you would have made a good Philosopher. But you've thrown your life away."

Celi had no reply. Huro was articulating doubts that had plagued him during his vigil on the mountain—in all those years alone, how could he not have had doubts? As he had worked through his monumental combinatorial challenge with his vials of infected blood and trial remedies, slaughtering generation after generation of white mice, his intellectual curiosity, even his basic impulse to save his wife, had worn away, leaving nothing but a grim determination to keep on to the end. He had even stopped counting the years as they had piled up. Of course he had been lonely, up there on his plateau, looking out over uncounted layers of time! But what choice had there been?

Well, he had succeeded, and he must not let Huro stir ancient doubts in his soul. "You Philosophers exploit the time strata selfishly—"

"While you have burned up your own life to save others. Yes, yes. You aren't the first, you know; your heroism isn't even original." Huro peered into Celi's eyes, his mouth. "You might have found your Blight treatment up there, Celi, but you sacrificed your own health in the process. I'd give you a year. Two at the most."

"It doesn't matter."

"No, I don't suppose it does to you, does it?" Huro's expression softened, just a little. "My offer still stands."

"What offer?"

"To come with me, downbelow. You may only have a year, but spin it out! Some of us are planning to go on, you know."

"Go where?"

"Down into the red. Nobody knows how deep we can go, how much we can stretch time before it snaps like an overextended sinew. Some of us dream of pushing on into the future, all the way to the next Formidable Caress. And if we can do that, who knows what's possible? Come with

me, Celi. You've given up almost all of your life. Surely you owe yourself that much."

But Celi heard a sound from a neighboring room. It was a soft gurgle, the cry of a waking baby. "I have all I need here," he said.

HuroEldon snorted. "Well, we won't meet again. The time-streams will see to that." The Philosopher walked out of the house.

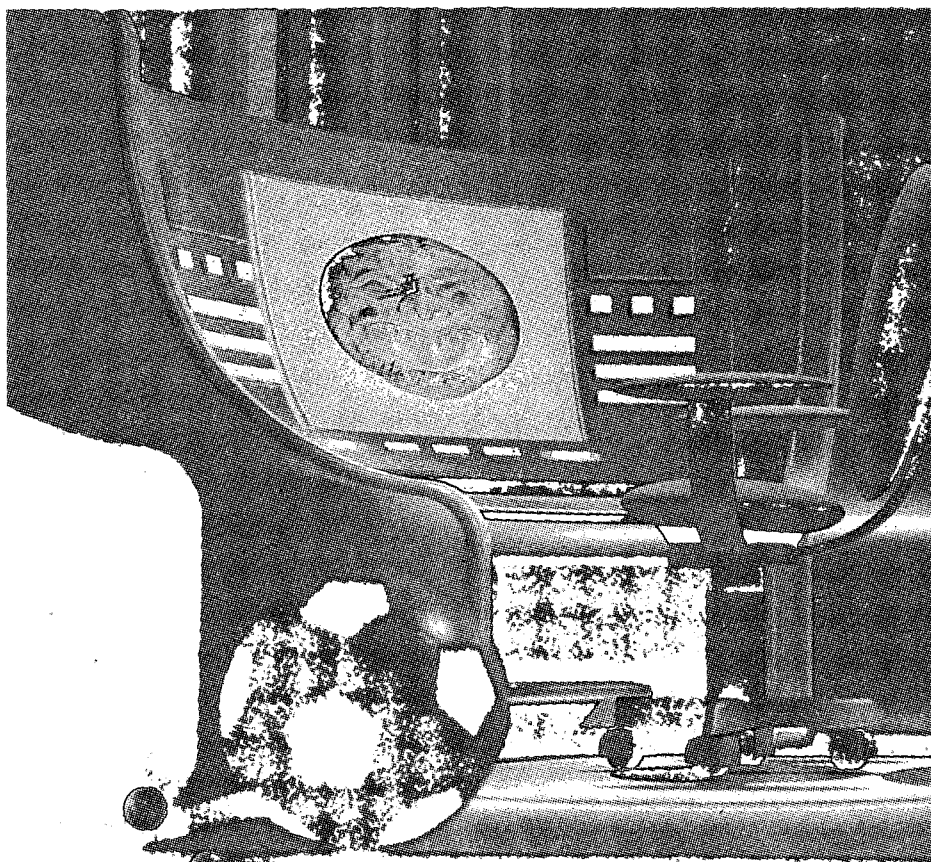
And Celi, broken and old, went to comfort his infant son. ■

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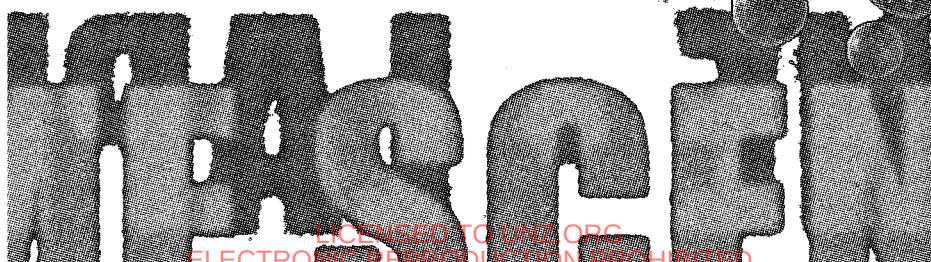
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TelePresence

Michael A. Burstein

Illustration by George Krauter



Catherine Harriman was doing her homework when she died.

Her physics teacher had assigned the class an exploration of Newton's three laws of motion, and so right after dinner, she rushed back to the family's virtual reality room to jack into telepresence. She settled her body into the simulator, pulled on the datagloves, and fitted the spex over her eyes, expecting to find herself back in the classroom.

Instead, the instant she entered VR, a blinding light hit her, accompanied by a loud explosion.

Catherine put her arm up to cover her eyes. *What the hell's going on?*

Then she heard friendly laughter.

"Who is that?" she said aloud.

"It's me," came a familiar voice. "How do you like my new instant greeting?"

Catherine dropped her arm. Rosa Guiterro stood in front of her, dressed in a silvery jumpsuit that flowed like water.

"Rosa! Have you been waiting for me?"

"Sí. I wanted to surprise you with my new greeting."

"Well, you certainly did. But please don't do it again."

"Aw, come on, Cath, it was just for fun. I wanted to try out my new hello on a friend before surprising one of the boys."

The two girls giggled. "You mean before surprising Jason, don't you?" Catherine asked.

Rosa winked. "Hey, forget the greeting. What do you think of this?" She floated up a meter and twirled around. Her outfit shimmered and glimmered, and Catherine could clearly make out "enhancements" underneath the avatar's virtual clothing.

"You're wearing pads," she said.

"Only in VR," Rosa replied. "I wish they'd let us wear these things in school."

"You know the rules."

"Yeah." They both did. After hours, students could portray themselves any way they wanted within a certain set of guidelines. But during the school day, they had no choice. Whatever appearance you had in real life that morning was what got scanned into the system. Without that dress code, Catherine imagined, almost all the girls would give themselves a little extra padding. The boys would probably show off fake muscles as well.

Rosa floated back down to the floor. "Listen, Caitlin and Naomi are supposed to be meeting me at the VR Mall in a few minutes. Want to join us? We're planning to set up a floating chat space so everyone can see us."

"Later, chica. I got to get to work on physics."

Rosa stuck her tongue out at Catherine and disappeared. Catherine smiled, shook her head, and got to work.

Mr. Lynch's assignment had been to start in a standard environment, in which the three laws of motion (and, come to think of it, all the other laws of physics programmed into the network) mimicked the real world exactly. Then you had to suspend each law individually, and come up with a demonstration that clearly showed how motion was affected.

Catherine always enjoyed these types of homework assignments, no matter how hard she found them. But she always liked to begin from scratch. So she waved her right hand from one side to the other, and the classroom around her changed to a large, empty room with white walls. Waving her hand wasn't necessary, of course, but she enjoyed the feeling of casting a magic spell.

Let's see, she thought. The first law states that an object in uniform motion stays in its motion unless acted upon by an outside force. So what if objects just randomly speed up and slow down for no reason? That sounds like fun.

She waved her hand again, and a collection of eight perfectly round spheres in all sorts of bright colors appeared floating at eye level in a circle.

She manipulated the spheres, first increasing their size to that of bowling balls, and then decreasing them to the size of baseballs. Next she changed their colors so they spun around in the order of the spectrum: red, orange, yellow, green, blue, indigo, and violet. She made the last one transparent.

I bet Mr. Lynch will give me points for that. He's such a dweeb.

Finally, she was ready to try her experiment. She released the hold of both virtual gravity and Newton's first law on the spheres, and with a wave of her hand, set them all in motion.

The spheres started moving as if they had minds of their own. Catherine watched as one sphere kept speeding up and slowing down in a straight line towards the other side of the room. Another sphere moved in a widening spiral, almost crashing into a sphere that zigged and zagged all over the place. Catherine smiled at her handiwork. She raised a hand to record her simulation—

—and a sphere smacked her in the back of the head, almost knocking her over.

"Ouch!" she shouted. She rubbed the sore spot and turned to look behind her, where she found the blue sphere sitting on the white floor.

What the hell? That wasn't supposed to happen. Virtual environments were programmed to be safe by the telepresence school authorities. Even if a ball had hit her during gym, she wouldn't have felt any pain.

She stopped rubbing her head because her hand began to feel wet. She looked at it and gasped.

Red blood covered her hand all the way down to her wrist, as if a glove had been painted on her.

She began to hyperventilate, and took a few deep breaths to calm her-

self. The other spheres kept whizzing around the white room, leaving multi-colored trails in their wake.

This is nuts. Even if my head was bleeding, my hand wouldn't look like this. I'd better turn everything off and report this to the school.

She waved her hand to banish the spheres, but they remained in the room, flying around in all directions.

Catherine felt her heart beating harder against her chest. She had created the spheres; she should be able to destroy them. Perhaps she should do this one step at a time.

"Stop," she said aloud.

The spheres kept moving, and the blue one suddenly lifted off the floor and flew right at her face.

She ducked just in time. As the sphere sped by, she heard a drop in its tone and felt her hair pulled along with the wind.

"This is nuts," she said aloud.

"Welcome to my virtual world," an electronic voice said.

Catherine whirled around. "Who said that?"

"I did," replied the voice. "You're in my world now. I can do anything I want."

The spheres froze in their tracks. Then they floated slowly towards Catherine until once again they surrounded her in a circle, revolving around her at eye level.

Catherine felt herself sweating under the datagloves. She watched the spheres carefully, readying herself to duck. "Rosa, is that you?"

Electronic, buzzing laughter emanated from the walls. "I'm the Destroyer. I'm here to kill you, Catherine Harri-man."

The spheres suddenly stopped revolving around her. Instead, each sphere rotated around its own axis. Catherine watched as each sphere began to display a monstrous visage, which turned to face her. It was as if someone had painted the same pic-

ture on each sphere—a twisted face with huge eyes and a mouth full of jagged teeth.

The mouths began to move, and the voice echoed from each sphere. "Are you scared, Catherine? Are you frightened?"

For an answer, Catherine ducked below the circle of spheres and ran towards the closest wall. She waved her bloodied hand at its blank white surface, expecting a door to form so she could flee. But no door formed.

"Come on," she muttered. "I know how to do this."

She tried again, and still the wall remained blank. In desperation, Catherine ran at the wall, slamming into it with her right shoulder in the hope that maybe she had created an opening but couldn't see it.

The wall didn't budge. She felt her hair tingling with electricity, and slowly she turned around to look behind her.

Where eight grimacing faces had been, there were now more than she could count, forming a wall just a few meters away.

"You can't run, and you can't hide," said hundreds of overlapping voices from the spheres.

Catherine closed her eyes. "I've got to get out of here," she said aloud. The way to exit VR was standard: turn off the VR feed, take the spex off your head, remove the datagloves from your hands, and step out of the simulator. Since she couldn't turn off the feed, she automatically went to step two, and took the spex off her head.

It was a fatal mistake. Not only was her mind still trapped in VR, but now she was blind as well. She could still hear the voices, echoing in the distance, becoming louder and louder. "Catherine, Catherine . . ."

"Who is that? Just tell me who you are! Help!"

"I'm coming to get you . . ."

Catherine tried to put the spex back

on, but she fumbled with them, and they fell to the floor. Electricity coursed through her body. She felt a burning pain searing her from the inside out, as the electronic voices overwhelmed her ears with hysterical laughter.

That was the last thing she experienced before she blacked out.

"Mr. Louis? They're here."

Tony had been working in virtual reality when he heard the voice in his head; he pushed a button on the earpiece of his spex and watched the world turn dark. "Already? They're early."

"I know," came the voice of his assistant, Dawn Castner. Since Tony had turned off the spex, her voice now came over the intercom that sat on his desk.

Tony lifted the spex off his head and blinked a few times. He looked at the flatscreen on his desk that displayed an image of the outer office. Outside, his assistant sat at her desk while eight men and women in suits stood around. It bothered him to discover that all of the members of the commission were white. No one black like him; no one Hispanic despite the huge Hispanic population of the state.

"I guess we ought to begin," he said, glad as always that his voice could only be heard by Dawn over her earbud. He looked down at his blue jacket and maroon tie, just to make sure he still appeared presentable. "Send in the commission chair, please."

Tony watched on the screen as Dawn nodded and turned to one of the women in the group. She instructed the visitor to enter Tony's office, and asked the others to take seats and please wait, as Mr. Louis wanted to meet with the chairwoman first. Most of the commission members quickly sat down, but two of them lingered in front of Dawn's desk, challenging her right to keep them outside. The chair-

woman spoke to them briefly, and then they settled down.

Tony changed the view on his flatscreen to a neutral brown and stood up just as the door opened. The view had not done justice to the chairwoman, a tall, striking woman whose solemn expression displayed a no-nonsense attitude. Tony walked around the desk to shake her hand.

"Suzanne Palmer, I presume," he said. "I'm Tony Louis."

She gave him a quick smile and then resumed her solemnity. "Indeed."

"It's a pleasure to meet you in RL at last. Please, have a seat."

As they sat on opposite sides of his desk, Tony watched Palmer take in all the old movie posters on the walls. "Eclectic," she said. "I like it."

Tony shrugged, doing his best to appear both unconcerned and grateful for the compliment. "I barely notice them anymore. I do most of my work in VR."

She nodded. "Makes sense, I suppose. But what if the system goes down, or some other problem arises?"

"Then I guess I can't do my work for that day. But it's no different from what happens in any office these days when there's a blackout. Your office is probably just as dependent on electricity as mine is."

Palmer nodded again. "You don't have to get defensive, Mr. Louis."

Tony frowned. "Was I? I apologize if that's the case."

She waved it off. "Don't worry about it. I was trying to see how you'd defend your telepresence system from such criticism." She paused. "You know that I'm personally in favor of adopting telepresence for California."

"So you've said over the phone."

Palmer took a deep breath. "However, you should realize that some members of the commission are still reluctant to turn the public school system over to you."

Tony clasped his hands together and

smiled. "That is why I arranged for this demonstration. I'm hoping it'll do more than preach to the converted. Is your commission ready?"

"Anytime."

Tony pushed the intercom button and asked Dawn to show the rest of the commission into his office. He shook hands with each one in turn and then said, "I'd like to thank all of you for coming all the way from Sacramento to Los Angeles."

One of the men said, "That's not exactly a hardship," prompting the rest to chuckle.

"True," Palmer said. "While here, we're planning to take advantage of it. I know of at least one holo studio I want to visit. We're also hoping for a tour of Grauman's Chinese Theatre."

Seeing an opportunity to promote VR, Tony said, "You know, Grauman's is one of many places that has made itself available for virtual tours as well."

A tall bearded man named Steven Silver grunted. "It's not the same," he said, and one of the women, a petite lady named Crystal Bordewieck, frowned and nodded in agreement.

Well, Tony thought, *at least I now know who my main opposition is.*

"It might not be the same," Tony replied, "but that doesn't mean it's worse. Especially when it comes to education."

Tony found himself going into lecture mode. He couldn't help it, but he tried to keep his tone light. "Telepresence is a form of communication technology, and education and communication technology have always gone hand in hand. The eighteenth century saw the start of our country's public education system. Most of our schools in the nineteenth century had little in the way of equipment: slate, chalk, a few books. By the 1870s, mass-produced paper allowed students to take their work home and share it with their parents, but not until the twentieth century did students abandon

their inkwells for ballpoint pens. Teachers went from blackboards to filmstrips to television sets and VCRs. As the old millennium ended and our century dawned, computers and the Internet changed the way we interact and do research."

"Mr. Louis?" Palmer said.

"Yes?"

She smiled. "Cut to the chase."

"Certainly. The upshot is that although VR technology has existed for many years, leading to the creation of the private telepresence school system, this technology has never been embraced by any public school system. It is my hope that with what you see today, you will decide that this system is right for California—and, perhaps, for the rest of the country as well."

He looked at the blank faces of the commissioners. "Are there any questions?"

The commissioners looked at each other, but no one raised a hand. Even Mr. Silver and Ms. Bordewieck remained silent.

"Then let's get started. Follow me, please."

Tony led them out of his office, and along with Dawn they walked over to the giant training room, with thirty full simulator units in five rows of six. He watched as the commissioners walked around the room studying the equipment.

"Is this a classroom?" one asked.

Tony shook his head. "All the classrooms exist in virtual reality. We use this room for training new teachers."

With the help of Dawn and a few other staff members, Tony showed the commissioners how to jack into their version of VR. He kept a careful eye on all of them as they put on their spex and datagloves and settled into the units. Two of the commissioners—not Mr. Silver and Ms. Bordewieck, unfortunately, as Tony would have expected—seemed to have looks of distaste on

their faces as they had to deal with the equipment. Fortunately, the rest of them, including Ms. Palmer, seemed to accept the technology with equanimity.

When everyone was set, Tony pushed his master switch and suddenly the darkness disappeared, replaced by a well-lit classroom with desks, terminals, and a screenboard. Tony stood at the front of the room, while the eight commissioners sat at desks.

"Well, what do you think?" Tony asked.

One of the women shrugged. "It looks like a classroom. I honestly don't see what's so special about it."

Tony nodded. "We always use a classroom as a baseline to begin the school day. It's a useful simulated environment. Most students are used to it, and we find that it sets the tone properly. But there's so much more that we can do here than is possible in a conventional classroom. Allow me to show you."

Tony took a deep breath and mentally prepared himself for the next hour, during which he would demonstrate many of the standard techniques that had been developed for teaching in virtual reality. A lot of them, he noted with pride, were techniques that he himself had developed to take full advantage of VR. He had planned his presentation carefully, to start with the minor techniques so he could wow the commissioners at the end.

"As I go through these demonstrations, I want you to watch for the three things where they help us the most: activities, self-direction, and focus. Those are the three categories we've kept in mind as we've developed ways of teaching in VR."

He started by calling up a variety of screenboards, one for each desk, to show how VR allowed a teacher to pitch material to each student at his or her own level. He showed how a teacher could meet each student's

needs precisely, so a gifted student and a student having trouble could interact in the same classroom and be of benefit to each other.

"In a regular school, a hyperactive student who needs to wander around every so often can be distracting. In VR, you can minimize those distractions, because you can allow that student to wander around in their own part of virtual space until they're ready to rejoin the class. More often, though, you can find some other way to engage the student whose mind is wandering. No one is ever bored here."

After a few other general demonstrations, he delved into specific subjects. One subject that stood out was biology. Tony demonstrated a frog dissection, performed on virtual frogs so that the students could avoid harming real animals.

"Recent polls show that a majority of our state's residents are opposed to animal experimentation," he reminded them. "We can dissect anything we want without killing, and the students can't cut themselves with the scalpels."

The commissioners seemed impressed with the detail in the frogs; a few of them even "ooh"ed and "aah"ed as they made incisions and removed the internal organs. Tony smiled as two of the commissioners compared the frogs' livers and realized that individual differences had been programmed in.

After a few more subject-specific demos, Tony turned back to the general. "Some of you are probably wondering how our teachers collect homework assignments," he said. "It's quite simple. All homework is done in virtual reality as well."

"All of it?" Ms. Bordewieck asked. "What if students need to visit a local library to do research?"

"They can and do, of course, but we also keep an electronic library in our system, and we're up to date on almost

every major publication. Even if a student does research outside of telepresence, they write their papers inside."

"What if they don't know how to type?" Palmer asked.

Tony smiled and snapped his fingers. A screen appeared floating next to him. "Watch," he said. He began to recite the alphabet, and as he did, the letters appeared on the screen.

"Our students can also handwrite their assignments," he said, as his words continued to appear on the screen. "If you look in the desk, you'll find virtual paper and pens. The system can tell them exactly how legible their writing is, so they can work towards better penmanship."

Tony snapped his fingers again, and the screen disappeared. "No more 'dog ate my homework' excuses," he said.

"How about 'The computer ate my homework'?" Mr. Silver asked.

"The computer is our system. If there was a glitch and the homework got deleted, we'd have a record of it and know that the excuse was legitimate." He paused. "Ladies and gentlemen, it's now time to show you the full value of a telepresence education: the ability to create simulated environments. Let me see..."

He hesitated for a moment over the earthquake simulation, then decided to go ahead with it.

"Ladies and gentlemen, for the next demonstration I must ask you to remain calm. I'm about to shake things up a bit, and I want to assure you that it's taking place only here in VR, and not in RL."

The group nodded, and Tony pushed a button on the desk. Suddenly the classroom began to shake, accompanied by a deep rumble emanating from everywhere. The commissioners jumped up in alarm.

Palmer darted to the front of the room and grabbed Tony's shoulder. "Mr. Louis! Please."

Tony pushed the button again, and

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the shaking and rumbling abruptly ended. A few of the people in the room sighed with relief, and Mr. Silver glared at Tony.

"What's the point of this?" he asked. "To frighten us?"

Tony shook his head. "Absolutely not. I apologize if you were frightened; most students find it fun."

"Fun?" Ms. Bordewieck asked. "You have got to be kidding."

"No, I'm not," he replied. "A lot of students liken the experience to an amusement park ride. They know that they're really safe. For those who have never been in an earthquake before, it's exciting."

"Surely that isn't the point," Palmer said.

"No, of course not. The earthquake simulation has two objectives. The first time I went through it, I lived in New York City, which, until recently, never experienced earthquakes. It gave me the chance to feel what someone living in California might experience. Made it easier for me to understand the news, and what led to the destruction of the original Golden Gate.

"As for the other reason . . . we've successfully used the simulation to teach older kids proper evacuation techniques. The original impetus for telepresence school was to develop the safest possible learning environment. Not only are students safe in their own homes, but they can learn how to stay safe in the real world."

"Of course," Mr. Silver said, "I imagine that during a real earthquake, a student might find himself trapped in your system, unable to flee."

"No. In the event of a natural disaster, or any other threat to life, the user is automatically disconnected from the system. There are safety features of that sort built throughout, and I'd be glad to provide you with as many specifics as you need."

Tony changed his tactics. "Ms. Palmer. Friends. I truly did not mean to

scare you but to enlighten you. The biggest strength of telepresence as an educational tool is our ability to simulate almost anything."

As he talked, the scene around them changed.

"I want you to imagine teaching astronomy on the surface of the moon," he said, and they found themselves on a lunar landscape, with a first-quarter Earth hanging in the sky. "Or teaching Shakespeare's plays in the Globe Theatre of his day," he said, and the desolate lunar surface melted into the pit of the famous theatre, with a troupe of actors in costume on the stage. "Or teaching French via real-time communication with native speakers," he said, and they were back in the classroom, but now there floated twenty screens on the front wall, each showing a different smiling face with a geographical location listed underneath. "Finally, we all know how art and music are always the first subjects cut when there's a budget crisis. What if you could teach art and music in a fully equipped studio, without ever needing to scrounge for supplies?" The classroom disappeared and was replaced by a divided room. On one side sat canvases, paint brushes, and easels; on the other sat a variety of musical instruments, including violins, cellos, saxophones, trumpets, recorders, drums, and one grand piano.

Tony waved his arm around. "That is the beauty of telepresence school. That is the promise of virtual reality," he said, and the room once more became a standard classroom.

"I hope you've found my demonstration helpful," Tony said. "If you have any questions—"

Suddenly Dawn's voice spoke in his ear; she sounded agitated. "Mr. Louis? May I interrupt?"

He nodded. Knowing that the other people in the classroom SE couldn't hear Dawn, he said aloud, "Folks, would you excuse me for a moment?"

My assistant needs my attention. Feel free to look around, do anything you wish. After all, another advantage of VR is that you can't break anything."

As the commissioners started walking around the virtual classroom, Tony walked over to a far corner. Subvocalizing, he said, "Dawn? What's going on?"

"We have a problem," she replied. "A big one."

Tony remembered many incidents of violence from his childhood. But his late mother had always done her best to protect him from the worst of it.

Nothing had prepared him for this.

Catherine Harriman's body lay slumped in her simulator. Her head hung to one side, with her tongue lolling out of her mouth. Her eyes were frozen open, glassily staring at nothing.

How horrible, he thought.

"Mr. Louis?"

Tony looked up. A man dressed in an impeccable blue suit walked across the yellow police holotape that the LAPD had set up as a barrier. As he crossed, the tape flickered a moment and then reestablished itself, with the letters "LAPD" continuing to scroll from one of the four emitter poles to the next.

"I'm Agent Cutter from the FBI. I've been sent from Washington to investigate this." He showed his badge to Tony, who peered at it, confused.

"You came all the way from Washington? For an accident?"

"If this is an accident, Mr. Louis, it's a dangerous one. I'm helping out the LAPD because of my expertise with odd cases."

Tony nodded. "There's no way that the telepresence system could do this," he said.

"Which is why I'm here. Mr. Louis, could someone have set up the system to do this deliberately?"

"Used our system to commit mur-

der? Impossible."

"Are you sure?"

Tony decided to conceal his true level of expertise. "I'm not really an expert on the technology, Agent Cutter. I came from the educational side. I developed techniques for using the telepresence system to improve education and then implemented those techniques over our entire California network."

"Is that what you do now?"

"I wish. I'm now the executive director. I run the whole system. Makes it harder to play with the details."

Cutter nodded. "I understand. That's why I never took an SAC job."

"SAC?"

"Special Agent in Charge. I prefer to stay in the field."

Tony stared into the distance for a moment. "I understand. On the one hand, I can do a lot more good for a lot more people from my current position. But on the other hand . . ." He looked at Catherine Harriman's lifeless body and shuddered. "On the other hand, I'd never even heard of this girl until today. You lose something when you're not in the classroom."

"Mr. Louis, I'm going to need your help in conducting my investigation."

"I'd prefer to do my own investigation," Tony replied.

"I'm sure. But in the meantime, I'd like to ask you for access to all the students in Harriman's classes, as well as the teachers."

"Of course. I doubt you'll find out anything, though. I'll have my assistant prepare you a list." He paused. "Will you want access to our system too, for the interviews?"

"Will I need it?"

Tony nodded. "As far as the telepresence system is concerned, all of California is one big school. Harriman may have lived in LA, but she's probably got classmates and teachers all the way from Crescent City to San Diego."

Cutter nodded. "The ultimate in de-

segregation."

Tony winced, and Cutter immediately said, "I'm sorry, Mr. Louis. I didn't mean to—"

Tony waved it off. "It's okay. No offense taken."

"Thank you. I like everything I've heard about telepresence school. What I said was meant as a compliment." He sighed. "But it does make conducting an investigation a lot harder."

"Will you want access to the system today? We can probably set you up this afternoon."

The agent shook his head. "I think I'll start with personal interviews here in Los Angeles. Then I'll take you up on your offer. But I'll still need access to your system to get a feel for what goes on inside. Virtual reality has probably changed a lot from the last time I was in it."

Despite his own expertise with their VR system, Tony knew better than to try to investigate the technological aspects of the tragedy on his own. When he returned to his office that afternoon, he assigned his Chief Systems Operator, Franklin Yee, the task of figuring out what had happened to Catherine Harriman.

It didn't take long. The next morning, Tony found a message from Frank saying that he had solved part of the puzzle and requesting a ten o'clock meeting. Since Frank lived in Oakland, the two of them met in a large white VR conference room, with normal avatars representing them.

Even sitting at a table, Frank still filled the room with his presence. As he talked, his legs shook back and forth and he gesticulated with his arms. "Our system's been compromised, all right. Let me show you."

A three-dimensional grid of white lines appeared, hovering above Tony and Frank. As Frank pointed at pathways, the ones he mentioned lit up in an eerie blue.

"This schematic represents a recording of the real-time connections that took place yesterday afternoon. You see this pathway here, and that one? They show that someone hacked our system."

Tony looked up in surprise. "This was an inside job."

Frank smiled. "I'm glad to see you still remember how to read the grid."

"You're the only one who knows more than I do, Frank," Tony replied. "Just because I've been working behind a desk all these years doesn't mean I haven't kept up with the technology. Can we take a closer look?"

"Certainly." Frank stood up, and Tony followed suit. The grid grew larger and larger until Tony and Frank stood on one of the blue pathways, now frozen in time. Other blue pathways, each about the width of a sidewalk, led off in all three dimensions.

"Follow me," Frank said. He walked along the pathway, and Tony stayed a few paces behind. They turned onto a pathway that curved upward into a loop and began to climb. Even though he had done this before, Tony still felt amazed at the fluidity of VR. As they walked up the loop, the environment changed its orientation. By the time they got to the "top" of the loop, it had become the bottom, and the rest of the world appeared rotated one hundred and eighty degrees from what it had been before.

The world turned upside down, Tony thought.

"Well, here we are," Frank said, falling to his knees to study the pathway. "We're standing on a VR feedback loop. Whoever hacked our system began by taking control of VR exactly where we are."

Tony joined Frank in examining the ground. At first, it maintained the appearance of solid blue. After a moment, however, Tony saw a series of tightly coiled blue fibers that gave the pathway its solid structure.

"I feel like I'm looking deep into the system," Tony said. "Like in one of those old cyberpunk movies."

"You would know about that better than I would," Frank replied with a smile. "Do you know what this really is?"

Tony hesitated. "A control loop?"

Frank smiled. "Precisely. Induced by the hacker himself. He managed to convince the system that he deserved the same level of clearance as you or me, and got the system to grant him full root access."

They stood up. "Well," Tony said, "even if he hacked our system, that still shouldn't have given him the power to kill someone."

Frank scratched his right cheek and looked away. "Well ..."

"What?"

Frank clenched his hands. "There are ways to kill someone in VR."

Tony felt stunned. "You're kidding. How?"

"Through fright, mostly. Put someone on a virtual roller coaster, and their mind and body will react exactly as if they're on the real thing. It's autonomic."

"Automatic?"

"No, autonomic. The nervous system. If you frighten someone in VR, their breathing will become rapid and their heart will beat faster, until their autonomic system goes out of whack."

"But that shouldn't happen. The telepresence system's programmed with safeties." He paused. "Isn't it?"

"Well, yes," Frank admitted. "But those safeties depend upon constant monitoring of a person's vital signs. They're usually set at a reasonable threshold, such as a maximum heart rate of two hundred beats per minute for one of the students. Change that threshold and you can kill someone."

"I'm not sure I understand," Tony said.

"Suppose you reprogrammed the system to turn off only if someone's

heartbeat reached *five* hundred beats per minute. Since that's not possible, the system would stay on until the person went into cardiac arrest."

"Is this really possible?"

"Well, you or I could program it, as could members of my team. But most people wouldn't be able to do it."

"So is that what killed Catherine Harriman?"

Frank's eyes darted back and forth, as he studied the grid. "Maybe. I have no idea if that's the exact method the killer used, although we do know that she died of cardiac arrest. It's just one of many possible ways to kill someone in VR."

Tony resisted the urge to grab Frank by the collar and ask him why he had never revealed this possibility before. Instead, he took a deep breath and said, "So how do we find this hacker before he tries something like this again?"

Frank shook his head. "I wish we could. But he covered his traces too well."

"Unacceptable. There must be something you can do."

"I'm sorry, Mr. Louis. Unless he tries this again, I can't trace him."

Tony crossed his arms. "Fine. We're done for now. Put a full report together within the hour so I can pass it along to the FBI and the police." He paused. "As much as I hate to say this, if they request it, I'm authorizing you to give them full access to our system. Maybe they have ways to trace this hacker that we don't."

Tony emerged from VR, and was surprised to discover that it was past noon. His stomach gurgled, and an empty feeling inside reminded him how long it had been since his breakfast of bran flakes in soy milk. He pinged his assistant, who was eating a salad at her desk.

"Dawn, could you get me something from the fridge?"

"Sure. I'll pop in one of the hydrowave lasagnas."

"Thank you."

Tony leaned back in his chair and stretched his arms. He felt the ache in his back muscles, and he reminded himself to get some exercise before the week was out.

"Mr. Louis?" came Dawn's voice over the intercom. "I haven't had a chance to get your lunch yet; you've got a phone call from Suzanne Palmer. Do you want me to tell her you're busy?"

"No, no, I'll take it now. Thanks." He pushed a button on his desk, and Palmer's image appeared on his screen. "Ms. Palmer. What can I do for you?"

"You can provide me with some information. I presume you've seen the news this morning?"

Tony shook his head. "I've been consulting with our chief systems operator all morning. What was on the news?"

Palmer sighed. "The *LA Times* Holosite is reporting the death of one Catherine Harriman, a student in your system. They're saying that she died in her simulator, and that her death wasn't an accident. Do you know anything about this?"

Tony hesitated. "Nothing I'm at liberty to say."

"I see," she replied.

Neither of them spoke for a moment. Then Tony said, "I hope this isn't going to affect your commission's work too badly."

"Frankly, it is. Which is why I was hoping I could get some straight talk from you."

He sighed. "All I can say right now is that we're helping out the authorities and conducting our own investigation. We hope to have answers within the week."

"I'm afraid we need them sooner."

"I thought your commission wasn't making a final decision for a few months."

"We weren't, but the death of Catherine Harriman changes things. Four of the commission members want to end our study now and recommend against adopting the telepresence program."

Tony frowned. "Let me guess. Mr. Silver and Ms. Bordewieck are two of the four, right?"

"Oddly enough, no. I really shouldn't be telling you this, but your demonstration convinced them. However, the news about Catherine Harriman pushed four others in the opposite direction." She paused. "It was almost five."

"Who was the fifth?"

"Me."

"Oh," Tony said. "I see. I'm glad you're still giving us a chance."

She sighed. "For the moment, I'm willing to give you and the police time to find out what happened. It wasn't too hard to convince the rest of the commission to keep our study open; otherwise, we'd have no reason to continue enjoying Los Angeles at taxpayer expense." She gave Tony a quick smile, and he responded in kind. "But it's still a disturbing development, Mr. Louis, and I'd appreciate it if you could keep us informed of your progress as quickly as possible. Too long a delay, and I'll join the opposition."

Tony spent the rest of the day going over psychological profiles of the "students of concern" whose schooling had caused them to intersect with Catherine Harriman. There were a lot of them, which was not surprising, given the 150,000 students enrolled in telepresence school. To make things easier, he had decided to eliminate students outside of Catherine Harriman's immediate age range, so he only studied the files of students from grades ten to twelve.

The files made for fascinating reading as Tony explored the alphabet soup of students' issues: LD, ADD,

ADHD, NDD, and RFD, just to name a few. All the acronyms that psychologists had come up with instead of simply saying that a student was a pain in the butt.

As soon as that thought came to Tony's mind, he rejected it. It was true that he sometimes took the cynical view; but more often than not, a diagnosis of a student's particular problem led to treatment. Some students who didn't respond to traditional schooling thrived in virtual reality. He had even used the argument in his report to the commission.

But sometimes, Tony would think back on the years he had been a teacher and the frustrations he dealt with every day when teaching certain students. As sad as it made him, he felt thankful that he no longer had to deal directly with their problems on a daily basis.

His reverie was interrupted by Dawn's voice broadcasting into his VR office. "Mr. Louis? Could you come out of VR, please?"

Tony pushed the earpiece button and removed the spex. A moment later, the door opened and Dawn walked in. "Mr. Louis. Are you okay?"

"Of course, Dawn. What's up?"

She frowned slightly. "It's past seven. Are you planning on going home?"

"Seven? Already?" He glanced at the far wall where he kept his clock in VR; then, remembering that he was in RL, he checked his wristwatch. "So it is. I guess I lost track of time." He looked up at Dawn, who was biting her lip. "Why are you still here? You could have left at five."

Dawn sat down. "I was worried about you. I called Ben and let him know I'd be working late, and I called Sheryl on your behalf."

Tony nodded. "Thanks, Dawn. Was Sheryl understanding?"

"She will be once she receives the bouquet of roses you're sending her."

The two of them looked directly

into each other's eyes and cracked up. The laughter lasted almost half a minute, then trickled away.

Tony looked down at his desk and wiped away the tears of frustration and laughter. "Thanks, Dawn. I needed that."

"I take it you're feeling a lot of pressure about Catherine Harriman."

Tony sighed and looked into the distance. "This wasn't supposed to happen. Ever."

"You can't blame yourself, Mr. Louis."

"I know, I know. But still." He leaned back in his chair and looked at Dawn again. "Do you know why Timothy Easton developed the telepresence school system in the first place? He had lost a good friend in a school shooting. The point of the system was to eliminate all possibility of violence in schools." He shook his head. "Now look at what's happened."

"One killing in a thirty-year-old system. I'd say those are pretty good statistics, especially compared to the RL ones."

"It still hurts. Telepresence school is supposed to be a safe haven; that's the point of it all. It's what I remember most about my own first day of telepresence school."

His assistant looked confused. "You went to telepresence school? I didn't think—I mean—well, sir, back when you were a kid, it must have been expensive."

"It was."

"But then—I don't understand."

"It's okay, Dawn." Tony smiled. "I grew up poor, but I managed to attend a telepresence school starting in sixth grade."

"How?"

"I snuck in."

Dawn looked even more confused. "Were you a juvie?"

"Me? No, although it was only by the grace of my mother that I kept out of trouble. I grew up in Harlem, New

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York City." He paused. "I'm curious. What does that mean to you?"

Dawn's gaze unfocused for a moment. "Not much."

"I'm not surprised. Harlem's always been an odd neighborhood. Its history is filled with upswings and downswings. It was my bad luck to grow up during one of its lowest downswings, just after the Manhattan rezoning project, when Queens, Brooklyn, and Staten Island became independent. The wealthier parts of the city cut off resources to the poorer parts." Unspoken but understood by both of them were the racial undertones to that piece of history.

Dawn nodded. "Resources including schools?"

"Exactly. Those of us who grew up in Harlem got the worst of the school system. I always liked learning, but the school I attended as a kid—" Tony shuddered. "It was a bad place."

"In what ways?"

Tony fell silent for a moment, trying to decide what he felt comfortable sharing. Then he said, "The usual ways. Bullying, killing, the occasional rape."

Dawn gasped. "Rape? In sixth grade?"

"Be grateful that comes as a surprise to you."

Dawn nodded. "I am."

"Thank God for my mother. She knew I needed schooling, so she did her best to inculcate a love of learning in me."

"So did she sneak you into telepresence school?"

"No, I did that myself. Despite the zoning, my mother and I were allowed to go downtown, because she had a pass from her job. On weekends we used to run errands together. One day, as we were walking through the streets of Manhattan, I saw a pair of spex sitting inside a car, right on the dashboard. I'm ashamed to say that I took them."

Dawn's jaw dropped. "I have a lot of

difficulty visualizing you breaking into a car."

Tony smiled. "If you're having trouble visualizing it, perhaps a pair of spex would help."

They both laughed, then Tony continued. "Sometimes I still can't believe I did it. But I did, and for about a day, I took on the role of a kid named Andrew who wasn't as enthusiastic a learner as I was. Made the teacher suspicious." He paused. "I still remember how shocked I was when I looked into a VR mirror and saw a white boy staring back at me."

"I can imagine."

"Anyway, I spent the day pretending to be Andrew, until I was found out." He smiled and shook his head. "I still can't believe it sometimes. But the teacher, Miss Ellis, got me my own equipment and snuck me into the school again, this time under the name Howard." He paused. "At least I got to be black. After all, there were other black kids in telepresence school too, even though I never got to know them. But oddly enough, I became friends with the kid whose spex I stole."

"Really? Did he ever find out?"

Tony took a deep breath. "Yeah, he did."

"How?"

"I told him."

"Oh."

"Andrew had wanted to get together in RL. He thought I lived in Forest Hills, a swanky neighborhood in Queens County. Since he lived on Long Island, closer to me in real life than any other student in the school save one, he suggested that we make the time to get together and hang out for a day at a nearby playground. So I told him the truth, hoping that our friendship would convince him to keep my secret." He paused. "Two days later, I was called in to see Andrew's father. He was none too pleased with either me or Miss Ellis."

"What finally happened?"

"They threw me out, of course. Andrew's father was on the board of the school, and he was angry with Miss Ellis for sneaking me in. It cost a lot of money to run the system, and my presence meant that everyone else's bills would get higher.

"The teacher, though, Miss Ellis. She wouldn't give up on me. The following week she set up a home classroom in her brownstone for me. She spent the mornings teaching in telepresence, and the afternoons teaching me."

"Wow. She sounds like a saint."

Tony took a deep breath and nodded. "That's the most important lesson I learned from my experience, the commitment of teachers. It still amazes me how cheaply we regard education in the United States. Taxpayers don't see the benefits of public education. Too many of them think their money is being wasted." He paused. "Don't get me started on the wealthy, who send their kids to private schools. They're the worst."

Dawn looked flummoxed. "They're our clients."

Tony sighed. "I know, I know. But they were never the ones I cared about as much in the first place."

Dawn's shocked expression prompted Tony to backtrack. "I don't mean that I don't care about them, or their kids. I love the kids. But it always bothered me how private schools pay their staff less than public schools. Kind of made me wonder what that was all about."

"We pay less than public school," Dawn said softly.

"Yes, and I really wish we could pay more. Our teachers have been through much more extensive training. They deserve a lot more money. Maybe if we can convince the public schools to adopt telepresence, our teachers will finally get the money they deserve."

Tony rubbed his eyes. "Thank God most of them consider teaching a call-

ing. Could you imagine what would happen if one day all the teachers in the United States decided that the low pay just wasn't worth it anymore?"

The question hung in the air. Finally, Dawn broke the silence. "So why did you come to California?"

He shrugged. "Most people go to New York to reinvent themselves. But if you're from New York, where do you go? There's only one other city that has that same reputation of being able to make an unknown into a star."

"Los Angeles."

Tony nodded. "Exactly. So once I had finished my own education, I chose to move out here." He paused. "Let's not forget my love of old science fiction and fantasy films. It's a lot of fun living in the town that invented them."

Dawn smirked and shook her head. "I know you better than that, Mr. Louis. There's got to be another reason. A practical reason."

Tony smiled, pleased by Dawn's insight. "Well, yes, there is. California and Texas buy the most textbooks in the country. Like it or not, that affects what the publishers choose to publish. If you're going to make money in that field, you've got to be able to sell to California."

He paused. "Do you see where I'm going with this? As far as public education is concerned, where California leads, the rest of the nation is sure to follow."

"So if California adopts telepresence ..."

"It'll be the biggest step in pulling it off all over the United States." He yawned and rubbed his eyes. "Enough of this. Go home, Dawn. I will too. I think I need to get some sleep."

Dawn smiled. "That's a good idea. After all, it is a school night."

Conrad Haise was practicing on a VR basketball court when both the ball and the universe got away from him.

Like many other telepresence students, Conrad participated in intramural sports. Having finally reached eleventh grade, Conrad was now eligible for the top tier, provided he could beat out enough of the seniors. So although the season didn't start until the spring, he had made a commitment to practice three times a week until then.

His coach had given him special permission to run actual game programs, so instead of dribbling around the court and shooting baskets alone, Conrad was deep in the middle of a real game as a center, with nine virtual players programmed at realistic skill levels.

He hefted the ball, ready to shoot it into the basket, when suddenly all of the virtual players froze, as if the system had crashed.

The ball flew away from him. It bounced against the wall once, then hit the floor. Then it rolled back to Conrad, until finally it stopped right at his feet.

Conrad shrugged. He bent over to pick up the ball—

—and once again, it flew away from him.

Okay. Something is seriously weird here.

Conrad walked over to one of the players, frozen in the middle of a running step. He waved his hand in front of the player's face, and nothing happened.

The ball rolled slowly towards him, and came to a stop at his feet. Conrad examined it for a moment, then bent over to pick it up.

As soon as he touched it, the familiar reddish-orange rubber ball turned into a translucent solid sphere. Conrad brought it close to his face and looked through it, watching it shimmer.

It looks like water, he thought. *A solid sphere of water.*

He closed his eyes, and when he opened them again, the VR world

looked the same. *This is too weird. I'd better end the session and report this.*

Conrad opened his mouth to speak a command, but before he could say a word, the ball of water thrust itself onto his head. Conrad began to choke.

Then, without any warning, the virtual players vanished and the court became a swimming pool. Conrad found himself covered in water, flailing his arms around, with his mouth and nose filled.

He struggled against the water, swimming to the surface, where he coughed and spit until he could breathe again.

"Help!" he screamed. He reached for the spex that he knew were sitting on his face in RL—

—and a burst of electricity illuminated the water. Conrad felt himself starting to burn, from the inside out, and fell into unconsciousness.

"It's another victim," Agent Cutter told Tony. "This time in San Francisco. Kid was found slumped over in his simulator, just like the Harriman girl." Cutter sat in Tony's office, still looking immaculate in his blue suit despite having just come from the heat outside into the cool air conditioning. Tony, on the other hand, kept wiping sweat off his forehead with the green handkerchief that Sheryl had given him just for that purpose.

"What's the kid's name?"

"Conrad Haise."

Tony pointed towards his phone. "May I?"

Cutter nodded. "Would you mind putting it on speaker? The local cops have spoken to the family, but I haven't had a chance yet."

Tony considered the question for a moment. "I need to make a condolence call, Agent Cutter. I'll let you listen if you want, but I'd appreciate it if you'd stay quiet and make your own call later."

Tony found the Haise family's con-

tact information and called them. An image of a young boy with sandy blond hair appeared on Tony's flatscreen, along with the kid's name, age, and grade: Paul Haise, 14, 8th grade.

"Hi, this is Tony Louis, the director of the telepresence school system. May I speak with your parents?"

Paul looked a little shocked. "Um. My mom's busy at a neighbor's."

"What about your father?"

He shook his head. "Dad died a while ago."

"Oh," Tony said. "I'm sorry. I'm calling to express my condolences on the death of your brother."

"Uh-huh. I found him."

Cutter leaned forward. He stayed out of the visual pickup, but gestured with his hands at Tony to indicate that he wanted to hear more.

Tony nodded. "Um, Paul, I hope this isn't intrusive, but would you mind telling me what happened?"

The kid shrugged. "I walked into our VR room and found Conrad in his simulator."

Tony waited for the boy to say more. When he didn't, Tony simply replied, "Thank you," despite Cutter's signals that he wanted more information. "Again, let me say how sorry I am. Will you tell your mother that I called, and that she can call me back at this number?"

"Uh-huh. Listen, Mr. Louis, I want to see my friends, and the police took my simulator away along with Conrad's for evidence or something. Can you talk to them? Most of my friends live in SoCal, so I need to go back inside."

Of course the kid would need his friends, Tony thought. *He just lost his brother.*

"You'll be able to soon, I promise. But for now, we've got to let the police do their work."

Cutter looked at Tony and raised his eyebrows, but said nothing.

"Thank you, Mr. Louis."

"You're welcome, Paul. Goodbye."

Tony turned off the video linkup, and Cutter spoke. "That was irresponsible of you. You can't promise that kid that he can go back into telepresence."

"What are you talking about?"

"I'm talking about two murders, Mr. Louis. Unless you can tell me that your system is safe, I'm going to have to shut it down."

"You don't have the authority."

"Be reasonable. You know that even in a regular school when there's a tragedy, the school closes for a day or two."

"Or the school stays open and provides grief counseling. How would it look to the families if we closed down?"

"Are you sure it's the families you're concerned about? Or is it the commission?"

Tony glared at the agent. "I resent that."

Cutter shrugged. "Resent it all you like. But I know what's going on, sir. Remember that I come from Washington. I can smell politics a mile away."

"You misunderstand me. The safety of my students is paramount. What I resent is the implication that I would feel anything else."

The two of them sat in silence for a moment, and then Dawn's voice came over the intercom. "Mr. Louis? Sorry to interrupt, but Frank Yee is calling from Oakland. He says it's important."

"Put him on the phone."

Frank's image appeared on the flatscreen, and before he could say anything, Tony spoke. "Frank, this had better be really important. I've got the FBI in my office."

"Good, good," Frank said. "They'll want to hear this as well. Has there been another incident?"

Tony looked up in surprise. "Well, yes. How do you know that?"

"Because my tracer worked. We got him."

Cutter pushed his way into the visu-

al pickup and looked at Frank. "Got who?" he asked.

"The hacker, of course. We know how to find him."

Despite Cutter's objections, Tony insisted that the two of them enter VR to talk directly with Frank. Since Tony's office only had a single pair of spex, they walked to the training room and entered telepresence via two simulators. Dawn came along to help Cutter into the system and at his insistence remained in the room, monitoring their conversation, in case they needed to be removed immediately.

As before, they sat in a large white VR conference room filled with a floating grid representing the pathways of the system. Cutter kept looking around slowly, as if he expected to be attacked at any moment.

"How did you find him?" Tony asked.

Frank pointed at a bunch of pathways in the grid. "Water."

"Water?"

He nodded. "The hacker programmed a basketball court to become filled with water, which is one of the most difficult things to program properly in VR. It takes thousands of petaflops to get it to follow proper physics."

"What in the world is a petaflop?" Cutter asked.

"A thousand trillion floating point operations per second," Tony replied without thinking. "Ten to the fifteenth power."

Cutter looked at Tony in amazement. "I guess you know more about the details than you claimed," he said.

"Tony's only second to me," Frank said with a note of pride.

Tony glared at Frank, and Cutter said, "Well, well, well. Hiding something, Mr. Louis?"

"Nothing important. I had Frank turn over everything we found."

Cutter grunted. "I'll let it go for now. I'm still not sure what a petaflop is.

Can I have an answer in English?"

Frank smiled. "It's a measure of computer speed. The VR processor has to run faster to simulate fluids than to simulate anything solid. Which means that if someone wants to control it directly, he has to stay in constant contact with it. He can't just program it and let it run on its own."

"So what you're saying is that he made himself easier to trace because he had to keep an open line?" Cutter asked.

"Yes," Frank said.

Cutter nodded. "That tells us something about his profile. The unsub didn't just want to kill Haise remotely. He wanted to participate directly in the murder."

"Unsub?" Tony asked.

"Unknown subject," Cutter replied. "You're not the only ones with your own jargon."

Frank pointed at the schematic. "The kid is something of a computer genius. You can see from these pathways that he did an excellent job of covering his tracks, by bouncing his presence all over the system. Frankly, I'd like to hire him to work on the network."

Cutter looked askance, and Tony glared at Frank again. "Let's see about justice first, Frank, before we start doling out mercy."

"Of course, of course," Frank said.

"Enough of this," Cutter said. "What's the unsub's name and address?"

"I don't know," Frank said.

Cutter raised an eyebrow. "You said you got him."

"I meant that I know how to find him in telepresence. But like I said, he's a genius. He knows we've found him in VR, and he's threatened to kill anyone who comes after him."

"That doesn't make sense," Tony said. "He can only do that in VR."

Frank rolled his eyes. "That's my point, Tony. No one knows where he is in RL. The only way to find his physical location will be to seek him out in VR.

Once someone has found him in virtual space, I can run a Levinsonian trace to find his location in real space."

"So the only way to find him is to go after him on his own terms," Tony said.

"Or we could wait for him to strike again. I might be able to—"

"No," Tony interrupted. "We have to stop him now."

"That means someone's going to have to go after him inside the system," Frank said. "Who's going to do that?"

"Me," Tony said.

For a moment no one said a word. Then suddenly the three of them were joined in VR by Dawn, who had a worried look on her face. "Mr. Louis, no. You should let the police handle it. They'll find him eventually."

"What are we to do in the meantime? Close down the school system?"

"Don't forget the commission," Dawn added.

"Honestly," Tony said, "they're the last thing on my mind. I'm worried about the students." He turned to the FBI agent. "Agent Cutter, here's my plan. Frank will keep a trace on me as I go into the system. Once I've found the kid, he can get an RL location for you. Then Frank pulls me out of the system, and you have the local cops pick the kid up wherever he is."

Cutter shook his head. "I don't like the idea of a civilian going after the killer."

"It's my system, Agent Cutter. I'm responsible, and as you've just learned, I know more about it than almost anyone else in the world." He paused. "To be blunt, you don't have the authority to stop me."

Cutter took a deep breath. "Fine. But I'll want to stay in the loop at all times." He looked at Frank. "Can you program this system to fight the kid, so he can't hurt your boss while he's inside?"

"That's certainly possible," Frank said. "Maybe I can reprogram the safeties, so they're harder for the kid to

override."

"I was thinking of something else," Tony said. "Frank, earlier you said that the kid had achieved some sort of root level of access to the system. Do you remember when we programmed something even more powerful?"

Frank lifted his head back. "Yes. I remember."

"Do you still have the programs?"

"I . . . I think I can find them."

"Let me know once you do, and then I'll go after the kid."

"Tony . . ." Dawn put her hand over his. "Be careful."

Tony nodded and smiled, trying to put on a brave face while inside he was scared to death. "I will."

A few hours later, Frank and Tony met back in the virtual conference room, where Frank gave Tony a virtual handheld device.

"Here," he said as he passed over the tiny box. "The Omni."

Tony chuckled. "That's right. That's what I insisted we call it." He turned the device around a few times in his hands; it was smaller than a pack of tissues and had only one button and a screen. "Does it still have everything we gave it?"

Frank scratched his left ear and nodded. "You push that button and it'll give you absolute power over the system. Anything you want to happen in VR will, if you just think of it."

"The power of a god . . ."

"The power of good programming," Frank replied.

A thought occurred to Tony. "There's no way the hacker could have gotten hold of our programs, is there?"

Frank shook his head. "I kept them isolated from standard telepresence."

Tony nodded. "It's a shame, though. The Omni was the only way we were able to expand VR from sight, hearing, and touch to also include smell and taste."

"It was too dangerous," Frank said.

"Remember the last time we used it?"

"It almost fried your brains."

Frank nodded. "The human mind was never meant to be so directly connected to the computer-generated world. Seriously, Tony, don't use the Omni unless you absolutely have to." He paused. "That's another reason to find this kid. If we could study his brain, we might be able to figure out a way to create five-sense VR safely."

Tony sighed. First Frank had suggested hiring the kid as a consultant; now he suggested putting the kid under a microscope. His mind certainly went in many directions. "Let me find the kid first, Frank."

Frank nodded again. "Sorry. Anyway, I've set things up for you so the first step to finding the kid will be fairly easy. Just stay on the path I've traced for you outside the conference room."

Tony placed the Omni in a pocket of his jacket. "Thanks again, Frank."

"Good luck," he said, and he disappeared to monitor the system from outside.

Although Tony knew that he was being monitored by both Frank and Agent Cutter, he felt horribly alone. He deeply wished that Frank or Dawn could have stayed in communication with him while he found the kid, but Frank had advised against it, as that would make it easier for the kid to know they were trying to track him in the real world. Tony sighed and stepped through the door leading out of the conference room.

He expected to find himself in a hallway. Instead, he found himself in a dark void with glowing pinpoints of light scattered in the distance.

"My God," Tony said with a chuckle. "It's full of stars." He looked down at his feet to study the pathway that Frank had created for him. Just beyond the linoleum platform upon which he stood, a shimmering band of gold led off into the distance. Tony put his foot down on the band, and was relieved to

discover that it felt solid.

Then he noticed that the path was divided into tiny bricks, and he smiled. Frank often teased him for his love of old fantastic films. It must have amused him to arrange for Tony to follow the yellow brick road. He wondered if Frank had any other surprises like that in store.

Well, as long as I don't run into the Martians or any former California governors, I should be okay.

Tony walked along the road for about twenty minutes, resisting the temptation to step off into the darkness. He wasn't sure if he would fall or fly, but he knew that in either case he would get no closer to the kid.

Finally, he saw a faint blue glow emanating from the end of the road, and he stepped up his pace. A minute later, he found himself standing in front of an elaborately carved wooden set of double doors that displayed a graceful tree pattern. Huge glowing blue letters formed an arch above it.

Tony looked at the letters, paused for a moment in disbelief, and laughed out loud. The message read: SPEAK, FRIEND, AND ENTER.

Tony's laughter died down as he suddenly realized that perhaps the old movie cues weren't Frank's doing. The kid might be into old movies; it was common for adolescents who couldn't deal with the real world to retreat into fantasy worlds of books, films, and games. If that was the case, Tony might have a lot of difficulty making a connection with the kid long enough for the trace to do its work.

Then again, he thought, if the kid loves old movies as much as I do, maybe we'll have something to talk about.

He approached the door. Recalling how the riddle was solved in *The Fellowship of the Ring*, he spoke aloud.

"Friend," he said.

Nothing happened.

Oh, right. In the movie, the word

bad to be spoken in Tolkein's Elvish. He strained to recall the Elvish word for friend spoken by the wizard Gandalf.

"Mellon," he said. But again nothing happened. Tony pondered the riddle again, and then took a stab at it using California's second official language.

"Amigo," he said in Spanish, and with a loud creak the doors swung slowly outward. A stairway led upwards into darkness. Tony walked through the doors and began to climb.

The stairway ended at another door, this one painted white and with a brass doorknob. Tony touched the doorknob, and when nothing happened, he turned it and opened the door with a click.

Without taking a step, Tony found himself inside a teenage boy's bedroom. Books, data disks, and game wafers covered an unmade bed. A pile of clothing sat in the corner, spilling out of a closet. At the desk, typing on a virtual terminal, sat a kid. He wore a shirt of thick red and blue horizontal stripes. The kid's avatar emitted a green aura that told Tony he had found the hacker.

Tony uttered the code word "Peaches" under his breath, and felt a tingle as the trace began its work. It completed its first step, as the kid's name floated briefly above the desk, lingering just long enough for Tony to read it.

"Alex Hanover?" he said aloud.

The kid stopped typing and swiveled around.

"Ah. I see you found the place." He gestured around the room. "I recreated my bedroom in VR. Like it, Mr. Louis? It's an accurate, real-time environment."

Tony felt surprise at hearing his name. "You know me?"

Alex nodded. "Of course I do. You're the school principal."

"Close enough," he replied. "Do you know why I'm here?"

"Because of Catherine and Conrad."

Tony nodded. "I'm also here to help you. But you're right to mention your classmates." He paused, and then spoke more softly. "You shouldn't have killed them."

Alex scrunched his face up. "You don't understand. They all made fun of me when we first met in sixth grade. They called me Alex Pushover and kept doing it. Catherine and Conrad were the ringleaders."

"Alex, that was five years ago."

"Yeah, Mr. Louis, but I've been stuck with them since then." He looked at Tony with the beginnings of tears. "Do you know what they did last year? They earned my trust, told me that a girl I liked was just waiting for me to call her, and egged me on to confess my own feelings." He crossed his arms. "Well, I did, and it turned out to be a joke. I was the laughingstock of everyone."

"Why didn't you tell anyone?" Tony asked.

"I did. Three years ago. Instead of punishing them, you put me in different classes for a year. I lost out on the teachers I liked."

Tony sighed and tried to appear sympathetic. "I'm sorry, Alex, but I wasn't the one who did that to you. I hope you understand that." He reached out and put a hand on the kid's shoulder and felt gratified when Alex didn't pull away.

"Do you understand?" Alex asked.

Tony nodded. "I do. I know what it is to be marginalized. I grew up poor in Harlem."

"It's not the same," Alex replied. "If the world is so bad, then we should stay in VR all the time, where it's safe." A cold look appeared in his eyes. "That is, it will be, once I get rid of the bad people. The ones who make fun of us."

"We can't do that, Alex. Everybody is entitled to have access to VR."

Tony heard Dawn's voice in his ear. "We found him; he's in Palos Verdes. We just need another minute or two to

locate the simulator."

A loud alarm buzzed, and Alex looked horrified.

"You set up a trace." His blue eyes turned a deep red. "I thought I could trust you."

"Alex, you can trust me." Tony placed his other hand on Alex's other shoulder and looked him directly in the eyes. "I'm here to help you."

Alex jerked himself away. "You're just like all the others," he said. "You make me think I can trust you, and then you betray me. You've ruined everything."

He pushed himself up from his chair, which rolled into the clothing pile. His hands twitched. "I'm going to get you before they can get me."

He heard Dawn's voice in his ear. "That's it, Tony. I'm pulling you out."

"No!" he shouted. "He might run! I just need a little more time."

"Sorry, Mr. Louis," Alex said. "Your time's up."

As Tony watched, the bedroom and everything in it, including Alex, grew larger, until Tony was the size of an ant. He looked around for a means of escape, and ran towards the pile of clothes, hoping to hide underneath it.

"I'm coming after you, Mr. Louis..." Alex's voice boomed in Tony's ears.

Just before Tony reached the pile of clothes, he felt a hand grab him and lift him up, until Tony found himself staring into Alex's enormous face.

"I could swallow you," Alex said. "You're a nothing, just like all the rest."

Tony reached into his pocket, grabbed for the Omni—

—and using two thick fingers, Alex plucked it out of his hands.

"What's this?" he asked.

"Nothing," Tony said.

Alex tossed Tony onto the pile of clothing. Tony watched in alarm as Alex pushed his finger on the Omni, to no effect. "My fingers are too big to push the button," Alex said.

Suddenly Tony heard a cacophony of

voices intruding from the real world. "He's got the Omni!" "We have to pull Tony out!" "Give us a few more seconds!"

The room melted back to normal size from Tony's perspective, and he rolled off the pile of clothing and onto his feet. Alex now held the normal-sized Omni in his hand, his finger poised over the button.

Tony raised his hand. "Alex, don't do that. You don't know what that device will do to you."

Alex glared at him. "What is it? Don't lie, or else..."

Tony felt the crackling of electricity in the air. "It's an interface device. You push that button, and it will connect you directly with the system."

Alex's face lit up. "Even more directly than I am now? Cool."

He pushed the button, and suddenly he was covered in glowing blue pulses, which shot across his avatar in all directions. Tony recognized the effect from when Frank had last used the Omni; it meant that Alex now had ultimate control over VR.

"My God," Alex said, as the pulses flew. "I thought I had taken control, but this... What power. What incredible power."

The world around them started to change rapidly, reminding Tony of a flickering light. The bedroom disappeared, becoming scenes from dozens of old films, one after the other: *The Time Machine*, 2001, *Star Wars*, *WarGames*, *The Last Starfighter*, *The Matrix*, *Ender's Game*, *Lunar Revolt*, *Dorato Positive*, *Halt Catch Fire*, *Cracker*, *The Weather Hack*, *Higher Law*...

"Wait a minute," Alex said, and the images froze. He gestured with his hands, and suddenly the characters from different films started interacting with each other, in ways their creators had never intended. Neo from *The Matrix* sat at a computer from *WarGames*, connected to cyberspace

via a primitive acoustic modem. Charlie from *Dorato Positive* injected a virus into Roh Kwontae, the villain-turned-hero of *Cracker*. Android Delta C-7 of *Higher Law* plugged into Mycroft the AI computer from *Lunar Revolt*.

"Wow," Alex said. "I don't just control the world now. I control the people within it." He glared at Tony. "Including you."

Alex gestured again, and once again the world flickered through all sorts of environments. Tony was battered by changing pictures, warbling sounds, variations in temperature, bitter tastes, and even pungent odors. He tried to close his eyes and to cover his ears, but it didn't work. Alex was bypassing Tony's receptors, and using the ultimate power to mount an assault directly on Tony's mind.

Tony felt himself getting dizzy from all the direct sensory input. His heart started racing faster. His lungs strained to gasp another breath. He collapsed to the floor, knowing that soon he would pass out and die—

When suddenly, Alex vanished, and Tony heard Dawn's voice echoing inside his head. "Tony, they got him. They've disconnected him from VR. Do you hear me? You're safe now."

Tony nodded; his senses felt drained. He felt his body pulled out of the simulator by gentle hands, and he saw the real world replace the virtual world just before he fell into unconsciousness.

The next day, Tony sat in his office with Ms. Palmer, filling her in on the details of Alex Hanover's case. When he finished, she asked, "So what happens now?"

"He's in an institution for observation."

"What about his parents?"

"Father's dead. Mother claims she had no idea." Tony paused. "She's a rich lawyer who hired nannies to watch

over Alex, so she may be telling the truth."

Ironic, Tony thought. *Alex's second victim was also being raised by a single mother. They had more in common than either of them realized.*

Palmer's next words pulled Tony away from his thoughts. "I'm still concerned with the vulnerabilities of your system. As is the whole commission, now."

"Don't be. Frank Yee has gone through the system and fixed all the back doors that Alex used to give himself root access. No one will be able to do that again."

She shook her head. "It doesn't matter. Most of the members of the commission still think that a telepresence school system would be more dangerous than what we have now."

"I strongly disagree," Tony replied. "Think about Columbine and Beslan, just to name two examples. In one case, the violence came from within. In the other, it came from without. But in both cases, if the students had been spread throughout a telepresence network, the tragedies could have been averted."

"We don't know—"

He pressed on. "It's not the VR system that caused the deaths of Catherine Harriman and Conrad Haise. It's the same thing that always happens: cliques form, students bully other students, and kids become marginalized."

Palmer sighed. "My point exactly, Mr. Louis. Apparently bullying and marginalization still happen in your telepresence school."

"True," Tony admitted. "We've found that out now. But it happens much less often. Students are able to find many more people who share their interests, meaning that they're less likely to feel marginalized. They meet students from all walks of life, from all different backgrounds. Our school teaches something more important than simple reading, writing, and arithmetic. It

teaches tolerance and understanding." He paused. "Diversity, Ms. Palmer. That's why the VR system is even more important than before."

Palmer remained silent, and Tony handed over a pair of spex. "Would you put these on, please? I'd like to show you one final demonstration before you make your decision."

Palmer hesitated, then took the spex from Tony. He looked into her eyes and saw a trace of fear. "Please. Give me this last chance to convince you."

She looked back at him, nodded, and placed the spex over her eyes.

Tony pushed a button. "Ms. Palmer, I'd like to introduce some old friends of mine from telepresence school."

Four figures appeared: two white women, one Asian woman, and one white man. They greeted Tony, who nodded to each of them in turn.

"I've asked them to appear here today to give you some final testimony for your commission." He turned to the first friend, a woman in a white lab coat. "Janice?"

"My name is Janice Mann. I was born in San Francisco, but I spent most of my school years in Neptune Beach, Florida. During Hurricane Carol, my family lost everything. But I didn't lose my friends. I knew people from all over the country, and they were all hoping for things to work out. I think I would have despaired without that network." She paused. "I'm a physician today, specializing in disaster management."

"Thank you, Janice." Tony looked at the Asian woman; her avatar wore a flight suit.

"I'm Sandra Chang. I grew up outside Washington, DC. If it weren't for telepresence school, I wouldn't be where I am today. You see, my teacher encouraged my interest in space travel by letting me explore the planets of the solar system, on foot." She laughed. "I still remember how primitive some of the simulated environments looked,

But the fact is that I wasn't a book person. My learning profile showed that I was more of a visual and experiential learner. Traditional learning can't hold a candle to telepresence school in that regard. So, thanks to VR, today I'm an astronaut with the NASA-ESA Mars Project."

"Thank you, Sandra." Tony looked at the last woman of the group, who was dressed in a blue blouse and skirt, along with a black beret that completely hid her hair. "Debby?"

"My name is Debby Sommer. I grew up Jewish in Monsey, New York. If you know anything of that town, you know that it's a heavily religious Jewish enclave, and I barely saw anyone outside that world as I was growing up. Most girls in my community get a minimal secular education and then end up raising children and not having any sort of career. But my parents wanted me to know the world outside our own. So they enrolled me in telepresence school, and I got to see that there were many more options available to me. I still ended up as a wife and mother, and I'm still a part of my community, but I don't feel as isolated from the rest of the world as a lot of other people I know. I have a part-time job working in cultural outreach, which may go full-time once my children are older."

Palmer nodded absently, then turned to the last of Tony's friends, the white man. His avatar wore a sleek blue suit and a pair of wire-rimmed glasses. "Who are you?" she asked.

"My name is Andrew Drummond," he said.

"You I've heard of," Palmer replied with surprise. "The financier and philanthropist."

"I do a little of this, a little of that," he replied. "It's all because of Tony." He smiled at Tony, who smiled back.

"Explain," Palmer said.

Drummond nodded. "I was a snott-nosed kid. I grew up with wealth and

privilege, and frankly, I couldn't see the point of school. My mother spoiled me rotten. My father almost gave up on me, but then they introduced the first private telepresence school, in the Eastern time zone, and he saw it as a way to get me interested in learning. He never did things halfway, though; he became a major donor to the school and joined the Board of Trustees, all in the hope that I would start taking my education seriously."

"Did it work?" Palmer asked.

Drummond smiled. "Not at first. It was more fun than the other schools I had gone to, I'll grant that much, but I still didn't care for learning. It wasn't until I met Howard here that I discovered that learning could be fun."

Palmer looked confused. "Howard?"

Drummond chuckled. "That's how I got to know Tony at first. As a boy named Howard." He turned to look at Tony. "She doesn't know?"

Tony shook his head. "Tell her."

Drummond explained how Tony had broken into telepresence school, and how he had gotten to know Tony as a friend for a few months before he eventually found out the truth.

"I knew that what Tony was doing was wrong, and I was still pissed at him for having stolen my spex. I wanted him to be punished, and so . . ." He paused for a moment and glanced at Tony. "So I told my father, and he kicked Tony out of the school."

Palmer turned to Tony. "Is this true?"

"Yes," Tony replied. "But there's more."

Drummond continued. "I only knew Tony for a few months, but after I had gotten my revenge, I realized that I missed him. So I talked with my dad, and with my teacher, and I managed to reconnect with Tony. He came over to visit me in Port Jefferson a few times. A few years later, we found the scholarship money to bring him back to telepresence school."

"So," Palmer said with a hint of sar-

casm, "you would credit your interaction with this one person as the experience that changed your life."

Drummond chuckled. "Don't get me wrong. I'm not saying that I changed overnight. But Tony and I had become friends, and I really wanted to see him again. He was the only kid I knew who was willing to break through my obnoxious behavior and stay my friend. I think it was out of guilt for stealing my spex."

Tony shook his head. "It was your fault for bringing them into Manhattan with you, Andrew. That's what you got for using them to play games instead of just going to school."

They both chuckled, and then Drummond continued. "Games. Sometimes I still can't believe I wasted so much of my time on such trivial things." He shook his head. "In the end, Ms. Palmer, it took Tony here to show me what it was I was really missing. I'm not saying that I wouldn't have found a similar path without his help. But I'm pretty sure I would be a different person today if I hadn't become friends with him."

Palmer turned to look at Tony for a moment; Tony kept his gaze on Andrew.

"You see, my mom—well, there's no good way to say this. She didn't like black people." He paused. "She might have passed that prejudice along to me, if not for Tony. Because it's one thing to learn about other people through books and videos. But it's another thing to interact with them directly." Drummond nodded at Tony, indicating that he had finished.

"Thank you, friends," Tony said to his four erstwhile classmates. He turned to Palmer. "I hope this final demonstration has made its point. But I have one more thing to say before you go back to the commission to make your decision."

"We live in a world where we pay lip service to equality in public educa-

tion, but in reality, it's a joke. Some districts always have more money for resources, and some always get the short end of the stick. We both know how unjust that is. People can only truly be on the same playing field if they all have access to the same level of quality in their educational choices.

"Thurgood Marshall argued those same points in *Brown v. Board of Education* over a hundred years ago. Despite the Supreme Court ruling, the idea of equal access to education has always been something of a pipe dream. But with the telepresence system—"Tony paused. "Today we have the ability to make that dream a reality, for the public good. Don't let this one incident, as tragic as it was, destroy that dream."

Palmer pursed her lips for a moment, then nodded. "Mr. Louis, we will let you know."

Tony couldn't remember the last time he had visited the cemetery, here in the farthest reaches of Long Island. His memory told him that he had been here on a warm, sunny day in the middle of July, but which July? Not last year, not the year before . . .

The car came to a perfect stop in front of the gate, and Tony grunted as he pushed himself out of the back seat. The computer informed him that it would pull the car over to the nearby lot; and that when he was ready to be picked up he should just signal it. The door pulled itself shut and the car drove off.

It had been warm in the car; outside, the fall weather bit at his ears. An overcast sky lent a gloomy tone to the visit. Tony bundled himself more tightly into his coat, being careful not to hurt the flowers he held, as the cold wind brushed past him with a soft howl. His teeth began to chatter, and his feet crunched on the brittle leaves.

That's the one problem with spending so much time in VR, he thought.

You forget that you can't adjust the real world around you when it gets uncomfortable.

The grave was situated a short distance from the entrance, and Tony headed straight toward it. But after a minute of walking, he stopped short. In his direct path, he noticed a group of new mourners attending a graveside funeral, and heard the words of the minister pass over the coffin. "Ashes to ashes . . . dust to dust . . ."

Tony gave them a wide berth, paying his respects to the family by walking as far around as he could.

Finally, he arrived at the grave that belonged to the most important woman in the world besides his mother: his former teacher, Miss Ellis, who rescued him from a world of violence and pulled him into a world of learning. He stopped walking at the edge of her grave and noted with slight sadness that her plot no longer lay in an uncrowded section of the cemetery. Somehow, he always felt that her death should have been the last one ever, and it always bothered him to see more headstones gathered around hers.

Then again, she had always preferred a crowded neighborhood.

Tony read the words on the modest headstone to himself, words he had adapted from a famous Henry Brooks Adams quotation:

"A TEACHER WHO AFFECTED ETERNITY"

Miss Ellis had not had any family, and Tony had taken it upon himself to see that she received a proper funeral and burial. As he stood there, his mind drifted back to the bookends of his friendship with her.

He thought back to his first memory of the comforting Miss Ellis, the white teacher in telepresence who smiled at him instead of scowling. He remembered his shock the first time he met her in real life, and discovered that she was as black as he was, with a thick

red scar seared across her right cheek.

He also remembered the shock of the day he came to her door, and she didn't answer. He tried his thumbprint and discovered that it still opened the door. An odd smell had overwhelmed him, and he had realized it was the smell of death. According to the corner, her heart had simply given out while she lay sleeping a few days before Tony had come to visit. Once again, he wondered at a world in which a person could vanish and not be missed right away. He wiped away a bit of moisture that trickled down his cheek. He owed her so much, and there was no way he could ever pay her back completely.

But at least he could give her the news. He stared at the headstone and spoke softly.

"It's done, Miss Ellis. I took your dream, and I've made it a reality. Governor Gelb has signed the legislation. California's public school system will be completely moved to telepresence within the next five years. I imagine the rest of the country will follow suit within my lifetime." He paused. "I'm

only sorry you aren't still around to see it."

He bent over the grave and laid the bouquet of flowers on the grass. Then, recalling a Jewish custom he had learned about from Debby Sommer, he found a small rock and placed it on the headstone, to indicate that he had visited. It would most likely last longer than the flowers anyway.

The breeze suddenly died down, and a shaft of sunlight broke through the clouds, illuminating the ground and warming Tony's face. Then, as quickly as it had appeared, it vanished, swallowed up in the grayness of the day.

Tony smiled at the headstone, then turned on his heel and walked away. *The future still awaits us, he thought, and there is still so much to do.* ■

—with thanks to Tom Easton

(EDITOR'S NOTE: "TelePresence" is a sequel to "TeleAbsence," Michael A. Burstein's first story, which appeared in these pages ten years ago this month.)

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July Fourth, 2213

Peter L. Manly

Welcome back, listeners. This is the part of the program where we dig into the story behind the story. I know that with Comet Halley high in the sky, people want to hear about that. The astronauts have landed on the comet successfully and soon we'll have more samples. But let me tell you of other encounters with this heavenly object.

Our story begins in the year 1758, which was the first predicted return of the comet by Sir Edmund Halley, a major scientific feat. He didn't even live to see the return, but in that year at Glens Falls, New York was born a child named Daniel Smith. He probably didn't see the comet as a baby, but he would later. First he had to grow into a man. That included enlisting in the new American Navy and serving aboard the good ship *Duras*, which her captain promptly renamed the

Bonhomme Richard. He came back minus one leg, but plus one free country. He went back to where he'd grown up and proceeded to dam the upper Hudson River at Fort Edward, New York. There he established a sawmill. The dam still exists, but the mill and the subsequent paper processing plant are gone. Although highly modified, the dam is a major facility operated by the North American Flood Control Administration. The foundations remain the product of Daniel, 413 years later. Daniel observed the comet in 1834 at age 76, but he found it uninspiring, according to his diary, for the comet was brightest and most spectacular only when on the other side of the solar system.

Then let us skip forward, and I assure you that it's not a long tale, for there are only four characters in this story. In either 1850 or 1851, Daniel, then aged about 92, was carried to a

Fourth of July picnic at Fort Edward, New York and introduced, as the oldest living Revolutionary War soldier, to a boy named Robert MacDonald. Daniel advised the young man to look for the comet, which would return in 1910, when Robert would be 63 years old, an impossible number for a child to comprehend. Besides, Robert thought that the last war was in 1843 or 1812 and not 1776.

Robert did see the comet in 1910. He bought a telescope and showed it to his grandchildren. He had become a farmer and sired eleven children after serving briefly in the Union Army from 1864 to 1865, though he never saw battle. On July fourth, 1949, at 102, he owned the distinction of being the oldest surviving Union soldier from the Civil War (the Confederacy had other soldiers who lived longer).

In that year, at a Fourth of July picnic at Fort Edward New York, confined to a wheelchair, he met Richard "Dick" Cooney, a fidgety four year old. Robert advised Dick to look for the comet in 1985 or 1986, and he did. By that time, Dick was forty years old, had two children, and had survived Air Rescue combat missions in Vietnam, a little-known conflict. He'd had a successful career as an electro-optical engineer and physicist. He brought us the first known live television images (two dimensions only) of Comet Halley as seen from Earth via PBS television station KAET in Phoenix, Arizona. He briefly served on the U.N. High Commission to Eliminate Military Forces after the Last World War.

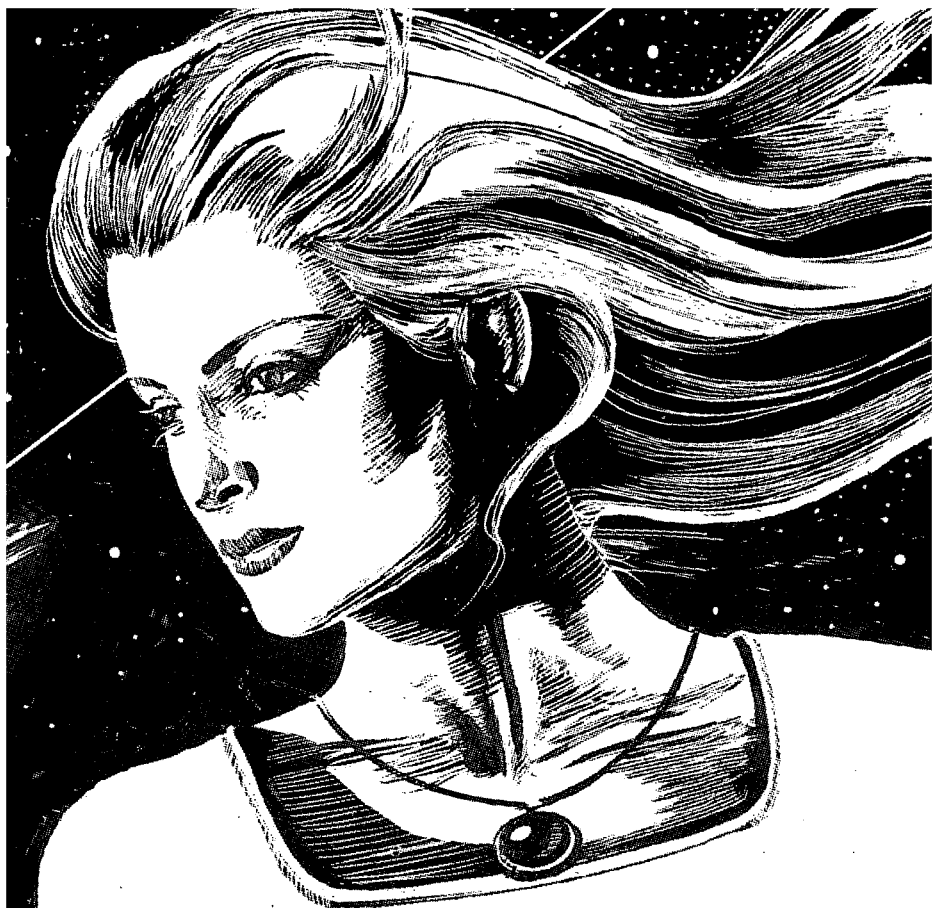
Dick got to see the comet a second time when he was 116 years old—not an unusual age for senior citizens now, but in his days such longevity was considered extraordinary. On July fourth, 2061, at a picnic in Surprise, Arizona, with Comet Halley high in the sky, rivaling the fireworks, Dick met Sally Bruns—Yes, that's Senator Bruns and I'm really sorry about her defeat in the

last planetary election, but this isn't about politics. On that day, she was about five years old and she sat on Dick's lap (actually, his powered legs, not the implants—these were the old style you strapped on) while watching images of the comet transmitted from the robotic *Aldrin* Lander Spacecraft. You couldn't manipulate the view back in those days. You had to get up and walk around to the backside of the display to see the other perspective. Dick told her to watch for the comet in 2137, for few people had seen it twice.

She did see it, but there were iron bars in the way, for this was during the time of The Troubles. She wrote that famous book during her unjust incarceration and she mentions in it seeing the Great Comet. Sally can weather anything and after she gained her freedom, she went on to help found our government.

Then this morning, just before dawn, Sally and I met as we often do (we live next door to each other) and watched the comet while sipping hot beverages and enjoying the cool air. I looked at her, at age 157, hovering in her anti-gravity chair, and felt awed by her presence. She's not the oldest person on Earth by a large margin. She's not the only person to have seen Comet Halley three times—there are hundreds of folks who are enjoying the apparition thrice. She is, however, the only person alive on the Earth, Moon, Mars or any of its space stations who has actually *met* a real live soldier! And now you know the story *behind* the story. Good Day! ■





Chandra's Pup

Bud Sparhawk

It's very hard to react appropriately
to something when you don't know
why it's doing what it does—
or what it is.

Illustration by Vincent DiFate

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Integrity oriented herself carefully so as to present the smallest possible target to the onrushing alien. Her Q-drives were poised to blink the ship away the instant it appeared to be in danger, a decision that would be conveyed by the switch in Captain Kurst's hand.

"Guns ready, sir."

"Engines ready."

"No reply to ping, sir."

As the reports came in from the other bridge positions, Kurst's eyes shifted from the scrambled hash of the deep scan to the fuzzy blob of white on the visuals. A year earlier an alien vessel had attacked before being destroyed. This could be another one.

"Object decelerating. Below two thousand kps," scanning reported. "Now under fifteen hundred."

Too fast, too damn fast, he thought. There was no way any living being could withstand the stress of such rapid deceleration. Unless the aliens had mastered a zero-inertia drive—which Fleet scientists assured him was impossible—the approaching ship had to be a machine, a robot from another civilization.

The image finally resolved from indistinct blob to something even less understandable—an unsymmetrical jumble of irregular spires and spikes projecting in all directions. Try as he might, Kurst could discern no order to the structure, no pattern that might indicate functionality or a purposeful plan of construction. It looked like nothing more than a space-going iceberg.

Integrity's hull vibrated from the power of its engines. Kurst liked to keep the ship under weigh so he could maneuver if need be. As long as *Integrity* was in motion, steering engines and mains at the ready, he had options.

And if all else failed, he had the switch.

Frigid water lapped at the beach, churning the ice into thick slush. Chandra Sushmarajopori drew her parka tightly around her. The thermal underwear, the heat-retaining clothing, a sweater, three pairs of socks, faux fur-lined boots, and thick gloves all failed to provide sufficient warmth to a body raised in warm, sub-tropical Madras.

"I hope the damned wind doesn't start up," she said to her fellow observer. "Cuts like a frigid knife through hot butter." The misstated cliché was apt. Even the faint breeze of their sled's passage could not qualify as a hot knife.

"Look! Over there!" Chandra squinted at a dark lump farther along the beach. "Is that another victim?"

Since the chemical spill a week before, the number of dead sea lions washing up on the beaches along the coast had increased significantly. Whatever they had used to disperse the spill had a terrible effect on the animals' coats, robbing their natural insulating capabilities and eroding its water resistance. In the end, unless the animals managed to reach dry land where they could clean themselves, they either drowned or succumbed to the bitterly cold waters.

"Let's hope we found this one in time," Chandra said as she opened the rescue bag and began pulling out the thermal blankets they would use.

She knew before she reached the body that the female was dead. Its head lolled to one side, tongue protruding, and eyes wide open in bitter accusation at the human race for bringing such disaster upon its kind.

"Look over there!"

Chandra watched the tiny creature, half the length of its mother, struggle in the surf. It looked exhausted. Nevertheless it crawled through the slush until it reached the side of the carcass and then mewed forlornly. Once, twice it butted its nose against the unmoving body before collapsing. It had to be ex-

hausted.

"Maybe we can save this one," Chandra shouted as she raced for the pup, the thermal capture bag popping open and flapping in the wind. "Call for help!" That would tell everyone that they had a rescue under way and bring the veterinary team. She hoped they'd bring some hot tea.

The pup seemed determined to get away. Chandra made a feint to drive it toward the yawning mouth of the bag and barely managed to pull back her glove as the pup snapped. "We're trying to help you, damn it!" she yelled and, at the same time, wondered how she would feel if someone was trying to herd her into a bag.

Ten minutes later they managed to capture the exhausted pup. She dropped a few doctored fish in the bag to keep it sedated until help arrived.

"Bad news, Dr. Sushmarajopori," the vet said. "They want you back at base. Some sort of emergency."

An emergency? That was puzzling. It couldn't be family-related; both of her parents were dead and she had no brothers or sisters. Nor could it have anything to do with work; all of her clients' problems had been addressed before she'd left. Glass manufacturers seldom had emergencies anyway.

The only possibility was some sort of problem with the forthcoming twenty-first century bubble glass retrospective she was helping Jeffery document, and she doubted even someone as flaky as he could invent a situation that would need her immediate attention. She was on vacation. There couldn't be an emergency!

So the call was a mystery. Just the same, the thought of a hot shower and steaming mugs of tea had a great deal of appeal after a week of living in survival shelters.

She was surprised to see a heli-

copter at the camp and even more surprised at the presence of a Fleet lieutenant. "Fleet has a problem, Doctor," he began before she could get her gloves off, "and your services are desperately needed."

Chandra was shocked. For years she had publicly railed, first against the bloody war Fleet had waged on the colonies, and later about the so-called protective force they continued to maintain. It was bad enough that Fleet should do that, but to then tax the colonies into paying for their own enslavement was beyond the pale.

"What happened, some admiral need a new set of dinnerware?" she shot back. "Listen, I'll have nothing to do with Fleet. As far as I'm concerned, you all can clean up your own messes."

The lieutenant leaned close. She was shocked at how young he looked. Were they recruiting kids now? No, he had to have completed school and training, so he must be in his early twenties or so. Perhaps he looked so much younger because she was not. Her twenties had passed too many years before, she thought regretfully.

"I'm allowed to say this much until you agree." He glanced around, leaned close and whispered. "Aliens."

They'd been sitting in orbit for hours when Chandra finally heard the whine of the packet's quantum drive spinning up. There were fifteen people in the fast carrier along with Chandra. Ten were Fleet and the others civilians. The packet was heading for *Integrity*—one of the two vessels Fleet was dispatching to the distant colony on Dzhou.

The briefing they'd given her on the alien raised more questions than it provided answers. What was perfectly clear was that some hotheaded Fleet commander had fired without provocation and, if the reports had been accurate, completely destroyed the alien

ship. *Leave it to the military to screw up mankind's first alien encounter,* she'd thought.

"Spin's up," the pilot said. "Departing."

Chandra lost all her romantic ideas about interstellar travel the instant the Q-drive engaged. Nobody warned her that blinking would give her the worst hangover she'd ever experienced. She also regretted the mess from the snack she'd eaten an hour earlier, despite the advice of the pilot. Nor had she paid too much attention to his warning that they'd be making a half-dozen quantum transitions, all equally terrible and in rapid succession.

By the time they rendezvoused with *Integrity*, every passenger, even the military types, were completely drained—in every sense of the word.

"It is just not possible," Premier Tu'un repeated. "There simply isn't enough in Dzhou's budget to fund your usual outrageous and unnecessary demands, let alone support these additional burdens."

Admiral Taylor fumed. His repeated requests for support, for repairs and refitting of his warships, had been met with a wall of indifference. It was as if the Dzhou government didn't care. Damn it, even if Fleet had been wrong when they destroyed the first alien ship, it didn't invalidate the fact that the aliens were a potential threat.

It was common knowledge that many in the Senate doubted Fleet's reports. The Dzhou Navy had considerable influence with certain senators and would do anything to promote their own interests, even if it meant choking off the Fleet's funds.

"You must remember that the presence of Fleet at Dzhou is little more than a nuisance," Premier Tu'un continued. "It is a reminder—a costly reminder—of how much freedom we have lost."

"We are only here to help and sup-

port," Taylor said.

"So you say, but I've been told that we could easily run our navy with a fraction of the money you want to spend so freely."

"Money be damned! How are we going to protect you if I don't have combat-ready ships?" Taylor shot back.

Tu'un raised an eyebrow. "Protect us? From what, I ask you? Am I to act on the basis of a dubious report and double, no, *triple* your already outrageous budget?"

"Admiral, the funds you demand come from the pockets of honest, hard-working citizens. It comes from people who expect my government to provide services, support, education, and facilities. It comes from people who want to see our economy grow; to build cities, expand the farms, and continue industrialization."

"Servicing the Fleet provides jobs," Taylor injected bitterly. He knew full well what the premier had decided.

"Jobs that need not be created when there are other priorities calling for our attention," Tu'un countered. "Tell me, from where shall I pull the funds you've requested? Would you have me halt the building of dams, or roads, or building a decent communications infrastructure?"

"Should I fail to respond to people impoverished by floods, fires, and weather? Or should I stop helping the needy children, the homeless, the unfortunate, or the disabled?"

"No, dear Admiral, I will ignore none of those simply to feed your Fleet's overarching sense of importance. Not now. Not next week. Not next month. Never!"

It would have been better, Taylor thought, had Tu'un shouted, instead of using the calm, level voice of a professional politician. He fought hard to keep his temper in check and the anger from his own voice. "The aliens are real, nevertheless. We need to have those combat-ready ships." He had an

almost overwhelming urge to grab this politician and shake some sense into him. "We are obligated to defend Dzhou."

"But the Fleet sent you sufficient resources," the premier insisted. "What about those additional ships?"

"*Integrity and Honesty* are barely twenty-five percent effective. Both need extensive refitting," Taylor admitted.

Tu'un sighed. "There you go, then. It was the Fleet's responsibility to ensure your reinforcements were adequately prepared. You can hardly expect the poor Dzhou colony to pay for them as well."

Taylor clenched his fists, feeling his fingernails bite into his palms. It was a mistake to come here. It was a mistake to beg the premier for anything. But he had thought that, as head of the government, Tu'un would at least listen to reason, that he would be willing to support the defense of his world.

He should have known better. Above all, Tu'un was a politician. "I thank you for your time, Premier," he said.

Tu'un checked his clock. "And I gave you far more than you deserve, Admiral. Good day."

Chandra hardly had time to get settled when she was taken, along with the other scientists, to a briefing on the alien artifact.

After a brief description of the encounter and destruction of the alien vessel, Nolan, the intelligence chief, got to the details.

"The big problem, and the one that worked most against our credibility," he began, "was that the total amount of debris we recovered didn't mass anywhere near what would have been needed to do that much damage to our ship. I believe we only recovered a tiny portion of the alien—the part that was glass. Judging from the impact probably eighty, ninety percent of the alien's mass is still out there," Nolan said.

"We've had crews out searching for the rest of it every since. We think it's seriously damaged, but still operational. We've swept every region within half a light of the encounter and found absolutely nothing. Nothing at all, until . . ." he paused and keyed the projector.

An image flashed into life, an image of something that looked like nothing so much as an iceberg.

"Look closely at this area." He zoomed the image of the alien craft until a small area filled the frame. "Note how these spires here," he pointed, "are truncated. We suspect that's what broke off when it hit our ship."

"Where did you get this?" one of the scientists demanded.

"A Dzhou Navy ship on search detail scanned this just before it was attacked," Nolan said. "Luckily they managed to get away in time, but just barely. The alien smacked them good and hard just as they blinked; killed their power systems and fried their generator. At least it didn't ram them like it did *Pride*."

Pictures were all very well, but Chandra wanted to see the evidence for herself. "How many fragments did you collect?" She was anxious to look at these, to hold an artifact of an alien civilization in her own hands, to feel some connection with these beings.

"Nothing substantial, I'm afraid. All we have is a few tons," Nolan replied, straight-faced.

Tons! She was expecting a few kilograms at most. How could she deal with so much material?

"Half of the fragments are very dense, a tenth are light, and the rest is somewhere in between. Different densities but not much else to distinguish them, at least from our limited knowledge." He nodded at Chandra, acknowledging her expertise.

"Did you discover anything else?"

"Sample number 154 had something

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interesting. We found a groove at the very edge of a fracture line. It was 152 millimeters long. Strange."

"How so?"

Nolan ran his fingers through his thinning hair. "No machining marks. That means the groove was formed as one with the rest of the glass. We found other holes, tubes, or whatever you want to call them, of varying dimensions within this same fragment.

"That groove might be part of an internal structure," Chandra mused aloud. Could it be a passageway, a channel for wiring, a duct, or part of a metal-free weapon that had generated the pulse that fried the search ship? She had to get her hands on the fragments and come up with some answers.

It was certainly going to be a challenge.

Her first dinner on *Integrity* was as bad as Chandra expected. The table was filled with grim military types and the rest of her science team. Kurst, the captain of *Integrity*, sat at the head like some ancient Lord of the Manor. What a pretentious ass, she thought.

They'd seated her between an overly solicitous marine officer and a lecherous Fleet lieutenant whose leg had pressed against hers a little too frequently. Directly across the table were a Dzhou civilian and a rather attractive Fleet captain.

"The civilian's Shwei Wen," whispered the marine. "He's the premier's military liaison. Next to him is Commander Simon Clay from *Pride*."

Clay! Wasn't that the name of the man who had destroyed the alien ship? She couldn't believe they'd seated her across from the very man who had ruined mankind's first peaceful contact with an alien race. She was infuriated.

Then she felt the lieutenant's leg touch hers once again.

"Oh!" he said as he jerked upright.

Kurst looked up. "Is something wrong, Lieutenant?"

The lieutenant blushed. "No, sir. Excuse me, sir." He left the table suddenly.

Chandra let her fork clatter on the table. "Something must have gotten into him."

"Well," the marine said during the embarrassed lull that followed. "It's been too long since we've seen you, Commander Clay. I'm certain your return to *Pride* will be welcome."

"Thank you," Clay said. "But I'm certain that any help I can provide will be trivial. I really know less than anyone here about the aliens."

Chandra spoke up. "Yet you fired on these visitors, didn't you? That seems a strange reaction in the face of your admitted ignorance."

"I believe my actions were fully justified, ma'am. You don't have a lot of time to study things when your ship is in danger."

"You fired first!" she shouted. "No wonder the aliens tried to flee."

Simon's face flushed with a flash of anger. "The bastards rammed my ship, lady!"

"That's what you claim. But it could have been the other way around. Your rash actions destroyed a priceless scientific treasure and possibly ruined any chance we might have to contact these beings."

"It killed thirty of my crew," he shot back.

"That's enough of that," Kurst shouted and then, while everyone sat in stunned silence, added, "Everything we've learned to date proves that the commander's actions were fully justified. Since then it's attacked a search ship, you know. That proves it's hostile."

"That's an unsubstantiated, self-fulfilling statement," Chandra said bitterly. "Just because one poorly maintained boat loses power you suspect it to be another attack? Where's your proof?"

It's your damned sailors that seem to see problems, not the alien's behavior!"

She threw down her napkin. "Consider this, you bloody warmongers. If Fleet hadn't shot first, we might be sitting here having a fascinating conversation with a new race, not thinking up excuses to annihilate them." With that she turned and marched away.

Simon seethed when he got orders from Admiral Taylor to cooperate with the science crew "to the fullest extent your duties permit." So help him, how did they expect him to work with that damned bitch of a glass expert when she obviously hated his guts, not to mention putting up with her low opinion of the Fleet? She'd made both views abundantly clear the previous night.

Nevertheless, when he got her request for an interview, he complied. Orders were orders.

"I want to hear your observations when the alien first approached you," she snapped without a word of greeting.

Simon balked. "Before I completely destroyed all hopes of humanity ever dealing with an alien race, you mean?"

"I'll never forgive you for that," Chandra answered through clenched teeth. "But, damn it, I still need the knowledge you might have in that testosterone-infused thing you call a brain. All I want from you is a first-hand account."

"I fired a warning shot and the alien rammed me and that's the plain truth." He turned on his heel and walked away. "Even if you don't believe what I say." He couldn't keep the edge out of his voice. Her accusation the previous night had awakened his feelings of guilt.

Chandra followed. "For the moment, let's assume that I believe you. What else did you see?"

Simon bristled. It was a sort of apol-

ogy, but he didn't stop. "All right then. The stern—that is, the part furthest from us—was a pale blue while the fore section was pale red. Is that what you wanted to hear?"

"You reported the colors as pale blue and rose. Awfully poetic language for a sailor."

"Are you an editor as well?" Simon snapped. "I can't see how that's important."

"The colors might tell me something about the translucence of the glass. I'd like you to see if you can match the precise color."

"Are we still assuming you believe me?"

"I have only contempt for you," she continued calmly. "I detest what the Fleet did in the war, their continued occupation of the colonies. And I especially hate having to try to keep up with you," she complained as Simon continued marching down the passageway. "But, damn it, I need your help. Yes, let's continue to assume that I believe you acted honorably."

"Why the devil did you leave Earth if you hate Fleet so much?"

She shrugged. "I was intrigued by the aliens and, to be honest, to get a look at this alien glass."

Simon grinned. "What's so exciting about glass? I can't see how you could make a living at it."

Chandra stiffened. "Until Fleet dragooned me, Captain, I was about to host a Chihuly large glass retrospective in Capetown. After that, I was to teach a master class on early zero-gee glass casting in Zeeland—that technique's in my latest book, by the way. Also, I have my own studio to run."

"You're just an artist?" He couldn't believe Fleet was wasting money on bringing her all this way.

"Listen, I do very well by consulting. There's lots of people who pay hefty fees for my services and knowledge, far more than Fleet offered, that's for sure." She turned her head to look at Si-

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mon. "This trip is costing me a bundle! If I had my way..."

As they turned the corner Chandra ran into a slim figure in a flight suit and staggered back. Simon caught her as she fell.

"Watch where you're going," Chandra cursed.

"I should say the same to you, ma'am," came the terse reply. "Just who the devil are you?"

Chandra drew herself up. "That's none of your damned business. Now, get out of my way so we can—"

"Teri?" Simon's voice stopped Chandra's diatribe in midsentence. The last person he expected to see on board *Pride* was Teri. He almost didn't recognize her in the flight gear.

Teri's face lit up in a bright smile as she took a half step toward him, her helmet dropped from her hand to swing by her side on its leads.

"What the hell are you doing here?" she exclaimed. "I saw you leave last year. How? Why?"

"It's good to see you again," Simon replied as he took both of her hands. "I missed you," he blurted before he could stop himself. "I thought you were on Dzhou. I was hoping to get down to spend some time with you. Catch up on..."

"Are you two going to stand here and gab all night?" Chandra interrupted. "Commander Clay and I have important business to discuss."

Teri glanced at Simon's chest. "You got your pips back!" she exclaimed. "How wonderful."

"They recalled me. The aliens, you know," he said. "I'm assigned to *Pride* again."

"Excuse me, but can't you two renew your acquaintance some other time?" Chandra said impatiently.

The meaning of Teri's flight suit finally dawned on Simon. "You're back in the cockpit again?" he exclaimed. "Maybe you can take me out for a ride."

"Oh, great, now we're into an excursion plans," Chandra growled. "When you are quite finished, Clay, I will be waiting." She stomped away. The partial gee made her stomping less dignified than intended as she bounced along.

Pride emerged from microblink right on target. "Scans?" Simon said.

"All clear, sir," scanning replied.

"What's our drift?" he asked.

"No discernable movement, sir," navigation reported. That was to be expected. Using the Q-drive bled off any residual motion, no matter how fast you had been moving when you blinked. There was a complicated quantum physics reason about position and velocity that Simon had never quite understood.

"All stations reported secure."

Engines turned. "Shall I shut down, sir?"

"Yes," Simon said. "All right, drives. Let's go with a quarter-light blink this time. Chief, sound the warning."

"I want a full scan, visuals and deep scan when we emerge," he ordered. That was routine combat protocol, but it didn't hurt to remind the bridge crew. "Guns, I want you ready to fire within two seconds of arrival."

"Spin's up, sir," drives reported.

"Engines, give us a ten-second burst from the mains the instant we arrive," Simon continued. "We don't want to be a sitting duck."

Simon felt his guts tighten as the drive engaged. The momentary nausea wasn't bad, but then, he was expecting it. He concentrated on the reports coming at him.

"Nothing on deep scan." "Visuals negative, sir." "Weapons tracking, sir." He could feel a vibration in the soles of his feet, confirming that *Pride* was in motion, just as he'd ordered.

Simon stared at the display. "Stand down, engines. Guns at ease. Power down the drives. We'll drift for a couple of hours and let the boat crew drill

for a while."

Simon wanted to be certain everyone in the crew was prepared for the exercise. "Battle stations," he ordered quietly as the klaxon blared throughout the ship.

The air pressure changed as doors slammed shut throughout the ship, isolating each compartment. A constant dialogue ran over the comm channels as stations acknowledged the order.

"Spinning up, sir," drives reported as Simon watched his crew go through their routines, interrupting only to clarify a command or note an omission.

Simon began reviewing the exercise scenario. Less than a light year away, they would encounter a simulated attacking force with Kurst commanding *Integrity* and Byles on *Honesty*. *Pride* would have to engage, evade, and, hopefully, destroy both frigates before they succeeded in killing her.

Simon knew Kurst would be the most dangerous opponent in this exercise. He'd been in three major battles during the war.

Byles had less actual combat experience, but considerable background as a tactician. He would be using every maneuver Fleet had developed since the war. He could give *Pride* some surprises.

Despite *Pride's* superior firepower, it would be two ships against one, so he was not optimistic about their chances. His objective was to stay alive as long as possible and, hopefully, nail one of them at least.

"Engineering, I want the ship turning at least thirty degrees to port during the burn. Use the gyros and the steering jets. We need to make it hard for them to predict our location."

"Guns, aye."

"Engines, aye."

"Scans and visuals—shout when you spot anything. Guns, I want those weapons tracking at all times. Everybody else, you know where your sta-

tion is. I don't want anything loose on the bridge."

"Scans, aye."

"Visuals, aye."

Simon tightened his harness and took a deep breath. His heart was racing. There was an unnatural clarity to his thoughts. It was all the adrenaline, he knew, and savored the familiar rush. It had been a long time since he felt that.

"Blink!" he ordered.

Signet officer Bam Sutra was one of those fortunate few who weren't nauseated by blink. Chief Forbes, however, was looking decidedly green, far different from his usual ruddy complexion. "Twenty freaking years in the Fleet, ten of them on warships, fought in eight major engagements, and rode god-knows-how-many training cruises," Forbes choked out between spasms. "You'd think I'd have gotten used to it by now."

Bam grinned. "It's just a matter of body chemistry, Chief. Some people are just born to suffer, I guess."

The chief made a comment which, had there been anyone else within earshot, would have landed him before a disciplinary board. But Bam ignored it. He'd gone through blink enough times with his chief that he knew it was just his upset stomach bitching.

"I'll check to see if any of our engineering crew have died," Bam said jovially.

"They'd be the lucky ones," Forbes groaned as he leaned over the bucket Bam had thoughtfully provided.

"I need someone to flit over to Pod Two and check the strain gauges we put on the new struts," Bam announced to his crew.

"I'll get right on it, sir," a hull rating replied. "Huito and Sarah will go with me."

"I don't understand why we got to do all this exercising crap," Bam overheard a nearby engines rating com-

plain as the three left. The man was a recent Dzhou transfer, Bam noticed. Probably never had done a combat blink before.

"Captain wants us prepared for anything comes to us," Bam replied. "That means we drill and check, drill and check until it's second nature."

"But who the hell are we going to fight?" the rating went on. "I mean, the Fleet's got the colonies under their thumb, so why waste time doing combat drills?"

Chief Forbes came into the compartment, still looking worse for wear. "We're doing it because Fleet and Navy say everybody's got to be combat-ready. That's why, sailor!"

Another rating shouted, "It was them aliens that's got the admiral spooked. That's why."

A third man chimed in, "Aliens, hell. Those things come out of blink space, they do. All crusty and spiky, all twisted like we get when we run through their space. They're coming to tell us to stop it."

As the hubbub rose to a general roar, Forbes raised his voice. "I don't want to hear any more damn rumors about rocks or blink-things or any other wild-assed stories your pea brains can dream up. Matter of fact, I've got a little list here that will make sure you won't have time to dream until we get back to port. Is that clear?" He pulled a wad of crumpled notes from his pocket. "Say, it looks like the sewage pipes might need another cleaning. How about that?"

There were a string of mumbled curses, but nobody suggested any more theories about the aliens.

Pride blinked. The deck vibrated as the engines fired and *Pride* slewed about to port. Stars streaked across the visual.

"No contact, sir," scans and visuals reported simultaneously. He'd expected nothing at this intermediate loca-

tion.

"Blink," Simon ordered and felt his guts wrench again. Some day he'd get used to it, he hoped.

"Bogie!" scans reported. "Five thousand clicks."

"Targeted," guns shouted. "Three away." The torpedoes hadn't actually fired, but their calculated tracks were following the predicted course.

"Incoming," scans said as *Pride* received the tracks of the others' shots.

"Blink," Simon ordered immediately.

Pride emerged a quarter-light away. "All clear, sir," scans reported.

"Stay alert. Whew, that was closer than I expected," Simon admitted. His heart was hammering, his vision crystal clear, and his mind was still trying to process the details of the brief engagement. He was unsure whether it had taken five minutes or only a few milliseconds. "It had to be Byles," he said finally. "A double spread is by-the-book Fleet doctrine."

What strategy would Kurst and Byles use, Simon wondered? Would they lie in wait for *Pride* to come to them, or would they seek her? There was always a question in this exercise—who was the hunter and who the hunted?

By now the wave front from that intermediate blink would have reached the location of their brief engagement.

The disturbance the drives made was detectable at great range, but the propagation of that disturbance was subject to the speed-of-light limitation. That meant that a ship was never where your sensors indicated. Depending on the distance, your scan might be light-minutes off of the other ship's true position. Add to that the speed of the missiles, which was nowhere near light speed, and the chances of pinpoint targeting a distant ship were negligible.

All of which meant a warship had to be very close to be certain it could hit anything. It was like a game of blind-

folded tag, where each player had a ten-meter pole and a two-meter spear—the pole being scanners and the spear, the weapon. Frustrating, boring, and scary. Sometimes it took weeks just to make contact. Most times battles were a few seconds long, with no certainty of success.

The only absolute certainty, of course, was when you were killed.

But Simon had experienced combat. He'd known the terror of not knowing when death was going to find you.

"Blink back to where we made the shot and run our programmed sequence. Maybe we can get an idea of where they might be waiting."

It felt strange, trying to outgun the ship that Teri was on, even if it was only an exercise. Thinking of Teri made him realize what had started as an interesting flirtation had become quite a bit more. Strange that he hadn't realized the depth of his feelings until now. Damn, he'd been such a fool.

"How did they know where we were, sir?" the scan rating asked, bringing Simon's thoughts back to the present.

"Probably dumb luck," Simon guessed. "We must have blinked practically on top of *Honesty*. There is no way they could have detected us, blinked to range, and fired so quickly.

"They're either doing zone defense or a coordinated pattern," he added after a moment's reflection. "That means both ships need to know where the other is so they don't shoot each other by mistake."

Their coordinated tactic wouldn't give *Pride* an advantage. Anything not in an assigned position would be fair game for them. Still, their strategy allowed *Pride* some flexibility; she could fire at anything.

Pride emerged from blink, took an instantaneous navigational fix, and then blinked again. And once more. And a third and fourth time as the program dictated. "Fix each location," Si-

mon instructed navigation. "We might need them."

The successive blinks had set up overlapping waves, each of which would move at the speed of light. Since they were at different distances, the other ships wouldn't know which wave front was earlier and which later. That made it harder for them to target *Pride*.

"First fix." This location was slightly offset from the engagement location.

"Target one thousand meters," scans said as another ship blinked into being.

"Weapons away," guns reported unnecessarily. Everyone on the ship could feel the vibration when the big guns fired their practice loads.

"Second fix," Simon ordered calmly. *Pride* blinked again.

"Got a signal," scans reported. "No, I'm wrong. That's our own wave front."

"Third fix," Simon said and braced himself. This time the weapons fired immediately, even before scans reported contact. "Son of a bitch! He caught on to what we were doing. Had to be Byles."

"Missed," visuals reported. "Target disappeared."

"Blink and follow," Simon ordered. There was no way of telling how far *Honesty* had jumped or whether she'd be waiting for them. "Let's go with a thirty-second light blink." That would put them nine trillion clicks away, practically next door in interstellar terms.

"Now, go back," he said as soon as *Pride* emerged. "Quickly, now!"

And there was *Integrity* sitting with her stern toward them a few hundred kilometers off. The big guns fired immediately. Simon had no doubt they'd make a solid kill. You couldn't miss at close range.

"We've registered a direct hit on our pods, sir," damage control reported an instant later.

"*Honesty* off our port side," visuals

ANALOG

reported at the same time.

Simon swore. Kurst had cheated. He wouldn't sacrifice *Integrity* in a real engagement. This wasn't a game, it was supposed to prepare them for combat.

The comm crackled. It was an incoming message from *Integrity*. "My compliments on the kill, *Pride*. Unfortunately, we have an on-board emergency in the engine room, so we couldn't move," Kurst said. "It's that damned sou-pinching tightwad of a premier who won't give us the funds for decent maintenance. Wish I had the son-of-a—"

"Anything we can do?" Simon interrupted. Kurst's explanation made him feel a little better about *Pride* taking the hit. "If it will make you feel better," he added. "*Honesty* nailed us a few seconds after we pegged you."

Kurst laughed. "And I was chewing Byles out for breaking pattern. Seems like we're going to have a lot of lessons-learned off of this one, Simon."

They were interrupted by alarms.

"Incoming," scans reported.

"Got them," visuals said a second later. "On screen."

Simon glanced at the display. There were three indistinct blobs of white centered on the screen.

"Five hundred thousand and closing," scans replied. "Two thousand kps." That meant they'd be here in less than four minutes, Simon realized.

"No SIFF," signals said. "Pinging." There was no response.

The comm crackled. "This is *Honesty*. What do you guys make of this?"

"Beats the hell out of me," Kurst replied. "Haven't seen anyone running without identification since the war."

"Can't be any of ours," Simon said. "Engines, move us between the incoming and *Integrity*." Given *Pride*'s mass, they would just barely have time to act as a shield for the disabled ship.

"How are you coming with those repairs, *Integrity*?"

"Almost finished, *Pride*. Thanks for

the cover, though. Give us some separation so we can test our engines."

"We're moving to intercept the bogies," Simon replied. "Chief, call battle stations. Tell them this isn't a drill. Guns, load live rounds."

No sooner had he spoken than the klaxons sounded and the chief's announcement rang from every speaker.

Honesty came on the comm link. "I don't believe this!" Byles said. "It's those damned icebergs!"

Simon remained calm. "Guns, I don't want anyone to fire without my order. We don't want to make any mistakes this time."

Simon wondered how this encounter would turn out. If it proved to be a friendly contact, he'd go down as the biggest fool in the history of the human race.

"Be prepared to blink away if anything goes sour," Byles said. *Honesty* moved forward to be slightly ahead of *Pride*.

"Range two thousand," scans said. "Five hundred kps."

"How the devil could they decelerate that fast?" Simon swore. The image on the screen showed that the three objects were arranged with the two smaller vessels as points of an equilateral triangle with the largest at the apex.

They were close enough that visuals could pick up the fact that all three appeared illuminated from within. The leading portions were rose red.

"Here they come," *Integrity* said. "Let's see what they—" The comm link went dead just as *Pride*'s lights dimmed.

"We lost power—now running on batteries," engineering reported.

The three objects were gone. Somewhere far beyond them, Simon thought.

"No reply from *Integrity*," signals reported.

"Did they get you?" Byles asked. "*Honesty*'s lost everything on the dor-

sal side."

"Same here," Simon replied. "I think they hit *Integrity* too. We can't raise them."

Comms shouted. "Laser from *Integrity*, Captain. 'Byles to *Pride*: take up guard position.' The scanner showed *Honesty* already moving toward *Integrity*."

As engines turned the ship, Simon asked. "Where did they go?"

"Range three thousand, sir," scans reported. "Closing at one thousand."

"Jesus! How could they decelerate to a halt and then accelerate so quickly?"

"Engineering. If we shift power to weapons, will we still have enough power left to blink?"

"Negative on the blink. One of the spinners might be fried—we're checking."

"Guns, track and fire at will," Simon ordered without hesitation. "Engines, give us a boost. I want to get as close to the big one as I can."

Pride leaped forward, weapons fired, the lights went out, and she drifted. "Everybody all right?" Simon asked in the darkness.

Suddenly he felt himself floating, which meant the main systems were down. Even the status lights on the emergency panels were dark. "Everybody stay where you are. Chief, get back to engineering to find out what the situation is. Tell them I want a status report soonest. On your way, tell the attack boats to use their radios to try to contact either ship."

Simon heard the chief release his harness and slip past. Like everyone else, he could find his way in total darkness.

"Commander, look here!" navigation said. Simon had nearly forgotten there was a port at that position for docking maneuvers. The sensors were so much better than human eyes that he'd forgotten you could see outside without instruments.

He hand-walked his way across the bridge and peered out. In the near distance he saw a few bright specks of light and, surrounding each, a nimbus of glittering stars.

"What do you make of it, sir?" navigation asked.

"Damned if I know," he answered. The lights might be *Integrity*. Maybe whatever hit *Pride* hadn't affected her electrical systems. But what could explain that strange halo around her lights? Had she been holed? Was he seeing condensed water vapor?

As he watched more lights appeared until they approximated the shape of a ship. With each addition the halo effect grew larger.

A moment later *Pride's* lights flickered, brightened momentarily before dimming, and then went out. "I guess that's my engineering status report," Simon said dryly.

Finally the lights came on and stayed. Gradually power returned to each position. Guns first, then scans and visuals, then comm, navigation and, finally, a definite sense of up and down.

"Let's get the damage reports," Simon said, grateful for the feel of the deck beneath his boots.

Byles called. "I think you got one of them. Good shooting."

One by one, the ship's sections reported. Aside from the loss of power, the only effects from the attack were some broken bones, contusions, and abrasions. Those were the normal things that happened whenever the ship's gravity asserted itself suddenly.

"The bogies have disappeared, sir," scans reported. "Hold! I have two small blink flashes."

"Are you certain?" The aliens' ability to blink would explain their mobility. He'd pass that fact along to Intelligence.

"*Pride*, glad to see your lights," Byles said. "Thought we'd lost you when the bogie exploded."

Rack up another one for guns, Simon thought. They must have hit one of the alien ships in the microsecond window they'd been given. "What's all that stuff around you?" Simon asked. "Did you or *Integrity* lose atmosphere?"

"No, that's the remains of whatever that thing was. I've got boats picking up samples. Listen, can you get over here and help me evacuate *Integrity*? Her electrical systems are completely fried."

Taylor was in a foul mood. He'd lost *Integrity*, one of his only three combat-capable warships, in this third encounter with the aliens, and had learned little more than before. "Let's get started," he said without preamble.

Nolan cleared his throat. "We've reviewed the records from *Pride* and *Honesty* and the conclusions are pretty clear. The aliens' incredible ability to accelerate and decelerate implies some sort of inertial control. Otherwise whoever or whatever is piloting these ships couldn't survive."

"We knew that before, from *Pride*'s earlier encounter," Taylor said. "Tell me something we didn't know."

Nolan hesitated. "Clay's original report from *Pride* was that the object they spotted was headed directly for them—and that it maintained that bearing. They saw the same uncanny targeting this time."

"So? Obviously they're hell-bent on attacking us. Is there something I'm missing?"

"Yes! Both times they were first detected heading toward our ships. That means they can detect us at longer range than we can detect them and, as we know from the war, that gives them a strategic advantage."

Taylor shook his head. "Any more good news?"

"We suspect that the red coloration on the leading edges is a weapon system—that's a gut hunch, sir. *Honesty*

must have been disabled by an emp-field impulse, apparently directional, but with substantial sideways leakage."

"You sound like you're talking about somebody's plumbing," Taylor sneered. "I imagine it was the 'leakage' that knocked *Pride* and *Honesty* out of service. Temporarily disabling the power systems on two warships and frying a third was hardly a small problem."

"Right, sir. The field density had to be well up there—maybe in the thousand-megagauss region. Not only that, but their weapons had enough reserve to immediately deliver a second blow."

"After which the survivors disappeared. Isn't that strange?"

"Well, we did hit one of them—that might have given them reason to run," Byles said.

"Or maybe they believed they'd killed us," Kurst guessed. "*Honesty* was barely on batteries, *Pride* was completely out, and *Integrity*, well, she was dead."

"At least you all survived."

"We lost three people, Admiral," Kurst replied softly. "And I've got another dozen in the hospital with various nervous disorders. That weapon of theirs scrambled their brains. I lost more than my ship."

"Point taken. But what sort of creatures would fight like that?" Taylor looked around.

"Perhaps our marksmanship made them think better of tangling with us," Byles boasted. "Maybe they decided prudence was better than confrontation."

Taylor thought Byles's hubris was way out of line, but said nothing. He was the best tactician they had, so feeding his ego was a small price to pay.

But, Taylor promised, he was not going to delude himself as to the Fleet's strength. The two remaining ships were marginally effective and still needed considerable work before they could face any substantial foe. He

sighed; it looked like he had to go begging to Tu'un once again.

"For all we know, they're still out there, beyond our detection range, while we're within theirs," Taylor said slowly and deliberately. "Does anyone disagree?"

There were no answers.

They were in a pickle, all right. They only had one Hellion; one operational frigate, at least until *Integrity* was repaired; three Medium Range Penetrators; an aging freighter; and four Dzhou Light Attack Ships. Even if they could enlist more Dzhou ships, it still wouldn't be a decent defense force. The Dzhou Navy was a toothless tiger, although they'd never admit their ships were little more than shells of their wartime selves. It was hardly enough firepower to repulse an invasion.

Nolan cleared his throat. "Let me summarize our options, sir. First, given the alien's detection range, we can't risk sending out patrols. Any lone ship could be picked off easily, and we can't afford to lose a single one. Second, we can't search for them; that would leave Dzhou unprotected."

"So what do you suggest we do?" Taylor said. He knew there was a recommendation lurking behind Nolan's summary. He wouldn't have stated a problem unless he had an idea. "Just in case your answer is getting those much-needed repairs and more ships from Fleet, forget it! I've heard nothing more, as you well know."

Nolan nodded. "I suggest we put every ship we can muster on an early warning perimeter along the vectors where the aliens have been spotted. We should maintain *Pride* and the other ships fully armed and on hot standby so they can blink to whichever picket spots the aliens."

"Good idea. Then shoot first, before they can get in range to use their weapons," Byles added vehemently.

"We'd be sacrificing the pickets,"

Kurst said grimly. "There's the time delay, you know."

"You're right, of course," Taylor said slowly. "But we have to take the fight to them, so to speak." He paused. "It looks as if we have no other options."

"Very well, I'll try to see if I can get some more funds out of the premier to get *Integrity* repaired. But let's be damn sure we can keep those picket ships safe."

Tu'un refused to see Taylor and, instead, sent a note that someone would call on him "privately." That was why Schwen Wei sat comfortably in the admiral's office, one arm draped easily over the back of his chair.

"I understand that Premier Tu'un has agreed to authorize the funds for arming the ships, Admiral," Schwen Wei said casually during a lull in an otherwise ordinary conversation about the status of the Fleet.

Taylor considered the information and what it implied about the premier's relationship with the man sitting across from him.

Schwen Wei's news about the funding was hardly surprising. Senator Ma's faction had been screaming about Dzhou's inability to defend itself ever since news of this latest encounter became public.

Senator Ma was now insisting that Tu'un be turned out for not having done enough to defend the colony. It was a strange turnabout, since, for over a year, he'd been the principal scoffer and had worked actively, if not publicly, to delay or deny every request to enhance the Fleet's capability.

Still, Taylor welcomed any support he could get, even when it came from his adversaries.

"I thank you for helping guide his decision," Taylor said dryly.

Schwen Wei shrugged the compliment aside. "Tu'un welcomes *informed* advice, Admiral. If he felt my interpretation of our ship's encounter

was of value, then I am honored." He paused, brushed a bit of lint from his sleeve and continued, "It is unfortunate that news of the first encounter was not greeted with similar enthusiasm."

"There was some skepticism about proof," Taylor said grimly. "No one in your government wanted to believe our evidence."

Schwen Wei agreed. "It may have seemed that way, I'm sure." The hint of a smile played at the sides of his mouth. "However, this time there was substantive proof that the aliens exist. This time you have reliable witnesses and recorded evidence. There can be no doubt now that these aliens are inimical to us"

"We still need to be cautious," Taylor said. "There remains the possibility that we might be totally misinterpreting their intentions."

"You do not try to engage an attacking dog in a dialogue or suggest that it attend obedience school, Admiral. You shoot it. To do otherwise is to court disaster," Schwen Wei replied with some heat. "No, my advice to the premier was to arm ourselves and prepare for the worst. With so few warships at our disposal, it is only logical that each one be as heavily armed as possible."

"Whatever the reason, I am grateful for the support," Taylor said. "But you didn't come here to tell me the premier's decision. He could have done that with a simple call."

Schwen Wei raised an eyebrow. "Direct and perceptive, just as Tu'un warned. Yes, I wanted to present a theory that your intelligence people and ours are dismissing as improbable."

Taylor started. Intelligence was not supposed to suppress ideas; they were supposed to collect, analyze, and encapsulate so command could make an informed decision. "Just how 'improbable' is this idea?"

Schwen Wei's pretense of relaxation disappeared in an instant. "I suspect that the attacks are no accidental en-

counters. That two alien ships coincidentally intersected the locations of our ships is simply beyond the realm of possibility. They had to be following a trail left from the first encounter."

Clay had brought the crippled *Pride* through thirty or forty microblinks to get her back home after that first incident. Nothing could follow their track. The workings of the Q-drive were such that there was no *there* between locations. A blinking ship did not pass through any intervening space when it shifted from one location to another. Endless experiments with precise clocks had shown that there was no time interval, no time loss, when a ship engaged its Q-drive. Following a ship's blink "trail" was clearly impossible.

But—and here his mind took a sudden leap—what if the aliens could track their ships? That was even more frightening than the long-range detection Nolan had postulated.

Simon got the call from Teri just as he came off mid-watch. "I wrangled a temporary transfer to *Pride*," she said. Looks like we'll be shipmates for a few days."

"Are you on board now? Tell me where you are and I'll be there in a few minutes. God, it's great to hear your voice again and—"

"Whoa. Slow down, Simon. I'm patched in through the command channel, thanks to a buddy of mine in comm. I'll be docking in about two hours."

"I don't go back on watch for another twenty hours," Simon replied. "We can—"

"I just want to talk, Simon. I've been doing a lot of thinking since you left, especially since that damned alien nailed *Integrity*. Anyhow, we do need to talk."

Simon wondered about that. Why was talking so important to her? Was she having second thoughts about renewing their brief relationship? Was

she going to tell him she wasn't interested any more? No, that couldn't be it; she wouldn't have called otherwise. Damn, why did she have this effect on him?

He was surprised to see the science crew and Chandra in the dock area.

"Ah, if it isn't the great war hero, Simon Clay," Chandra mocked. "I didn't realize the captain of the *Pride* would be greeting us."

Simon noticed the pile of equipment beside them. "What are you doing here?"

Nolan stepped forward. "Admiral Taylor's compliments, sir. He wants to monitor any contact with the aliens and provide whatever insights we can."

Simon was furious. There had been no warning, nothing from Taylor to prepare him. What the devil was he going to do with these people?

Chandra must have read his expression. "We're very eager to help if you encounter the aliens. I, for one, can't wait to see them in action. We might learn a great deal and perhaps figure out how to communicate with them. You do understand how important it is to communicate with these beings instead of shooting at them?" There was no doubting the sarcasm.

"I do understand," Simon replied. "Believe me, I want to communicate with them as much as you. Only I want to be sure they aren't trying to kill me first."

At that moment, a rating from engineering arrived with a cart for the baggage.

"Something else you ought to know," Chandra said. "The admiral gave us permission to observe bridge operations."

"I don't allow civilians on my bridge, ma'am. We can put you in navigation, if you'd like. They have the same screens as the bridge crew."

"So we'll be out of the way when

you meet an alien? Is that what you're saying, Commander? Are you afraid we might inject some sense into your aggressive tactics?"

"I don't know where you get your ideas, ma'am, but that's not the way I think or feel. All I'm trying to do is keep my ship and crew safe."

"At what cost to humanity?" she shot back.

"Better to ask the cost of not keeping humanity safe," Simon argued. "If you will permit me, ma'am, but you aren't thinking very clearly about this."

Chandra's face clouded. But before she could say anything, she looked beyond him. "Oh, I remember you."

Simon spun around. Teri was standing there, helmet in one hand and flight bag in the other. "Am I interrupting something?" she said. There was ice in her voice.

"Nothing of any importance," Simon said quickly. "We were just discussing the aliens."

Teri glared at Chandra. "Aliens. How very interesting."

Chandra smiled and took Simon by the arm. "Simon, you need to introduce me to your friend."

Teri bristled. "I'm Marine Commander Perry and if you don't take your hands off of my boyfriend's arm right now, I will do it for you." She hesitated a moment and then added, "Ma'am."

Chandra grinned. "Until later, Simon dear." She patted his cheek and walked away.

"I never . . ." Simon sputtered. "She and I aren't . . . I mean . . ."

"I heard the whole thing. You know, you are such an idiot," Teri said. "Here, take my bag and show me where I can get a shower. I've been in that damned cockpit for six hours and trust me, you won't want to get close until I'm properly cleaned."

Simon wasn't certain of what had just taken place. Why had Chandra suddenly acted the way she had after declaring her undying hatred of him, and

why had Teri called him her boyfriend? Lord, he wished he understood women better.

"These aliens, the way they so easily disabled *Integrity*, made me think about me, you, the future, and where I am," Teri said as they sat in Simon's compartment, the only private spot he had on the ship. "If things had gone the other way, if it hadn't been for *Pride*, I could have been killed."

Simon knew that gut-wrenching feeling well. He'd gone through it time and again during the war, and again when the aliens attacked. It usually disappeared during the action, but came crashing back as soon as you were safe once again. Such nervousness was part of being in the Fleet. It was part of putting your life on the line for the good of all, no matter what the cost. But that didn't matter when the time came. Ideals were nothing in the face of survival. You did terrible things and afterwards regretted them, but the experience always made you realize how much you appreciated life.

"I started thinking," Teri continued, "I remembered our fling and how I didn't want to get close, didn't want anything to happen. Damn it, Simon, we're Fleet—there wouldn't be any hope of a future for us.

"At least that's what I told myself." She hesitated. "You know, I didn't realize what I really felt until I saw you again."

Simon couldn't believe what he was hearing. "I feel the same way, Teri. When I ran into you, I..."

She held a finger to his lips. "Simon, I still don't hold much hope for a relationship. We'd never be assigned to the same ship, and I don't want a station-side job just yet. At best, we'd be able to catch the briefest moments in passing, if at all." She shook herself. "Damn it, what I'm trying to say is that I'm willing to give it a try, if you will." She looked expectantly at Simon.

Was that a yes or a no? What was he supposed to say? How did she expect him to react? Simon took a deep breath. "Sure," he said and pulled her toward him. "You know, I still have fifteen hours until I go on duty." Oh God! Now he'd done it, ruined the moment. Here she was asking for sympathy or commitment or something like that and all he could think of was getting her in bed. What must she think of him?

"Only fifteen hours? Then we'd better make the best of them," Teri replied with a smile.

Simon breathed easy. Somehow he'd managed to do or say the right thing. Now he could enjoy the rest of his time with her.

Teri snuggled close and put her arm across his chest. "Now, tell me what's really going on between you and that bitch you were hanging onto back at the dock."

Nolan strode to the podium as the officers filed into *Pride's* briefing room to hear Chandra tell what she had learned about the glass fragments. "I have some grave news," he began. "Yesterday, the freighter *Divine Promise* swept by Dzhou, heading for the sun at high velocity. When they intercepted her, they found that her crew was dead and her fuel exhausted.

"As best they can determine, *Promise* must have lost power soon after she emerged from blink, twelve days ago. She must have been in her initial boost phase when the power died. Obviously, the engines continued to fire until the fuel ran out."

He looked around the room. His face was grim. "Her records show that she'd encountered the aliens."

Simon couldn't help noticing that Chandra was somewhat taken aback by the news. Probably because it was a civilian ship, or maybe she finally started to realize that the danger they all felt was real and not some paranoid

fantasy.

"*Integrity's* being launched," Nolan continued. "She'll be on station within five hours."

Simon couldn't believe that *Integrity* was able to launch. Her repairs weren't scheduled to be complete for another month. "Is she combat-capable?"

"Her drives work, her engines work, and her guns are working. That's good enough for now," Nolan replied.

Not quite, Simon thought bitterly. Not quite good enough if Teri was going to be aboard.

The civilians were clearly upset by the news and their faces showed a mixture of panic and concern. "I want to leave," one of the scientists said apologetically.

Nolan cleared his throat. "You're civilians, so we can't order you to stay with the ship, but if we run into one of these things, I'd certainly like your observations."

"There's no reason for me to put my life at risk. I'll study whatever records you send back," the scientist replied and left the room.

Nolan shrugged, picked up his pointer, and began the briefing. "The science team's run an analysis of all the views and subjected them to discrete topological analysis," he began as a composite image flashed on the screen.

Each of the three objects was tinted a different translucent color. "We found that, by averaging their shapes, adjusting for scale, and eliminating unique points belonging to only one vessel, that their basic shape is a dodecahedron, embellished with spires and spikes of varying size." The images were superimposed on each other to illustrate her point.

"Like snowflakes," Simon suggested. "Or crystals."

"No, a snowflake is a hexagon and its final shape is determined by the varying temperatures it encounters. A

crystal has a regular structure—always. These have a basic shape, but otherwise there is no apparent similarity."

"Any conclusions?" Simon asked.

Nolan hesitated. "We think they must have been manufactured, quite possibly through nanotechnology."

Simon looked startled. "You mean there might be a danger to the ship from those fragments?"

"I doubt it," Nolan reassured him. "We'd have detected evidence of any sort of nanotech long before now."

"Thank God," Simon added. "Now, what about you, Chandra? Are you going to leave as well?"

"I'm conflicted," she replied. "The opportunity to study one of the aliens closely *almost* offsets my distaste for watching you destroy them." She paused, obviously trying to resolve her conflicting desires. "I'll stay," she bit out. "Somebody has to bear witness." She glared at Simon.

"Don't do us any favors," Simon shot back.

"Why don't you tell us what you've learned?" Nolan said in an attempt to get the briefing back on track.

Chandra picked up the pointer. An image of a fragment appeared. "This is sample 3294. It's a hard crystalline material of Type Four."

"Type Four?" Simon asked. "I thought glass was glass."

Chandra sighed, the exhalation of an instructor burdened by an exceedingly ignorant student. "There are many kinds of glass, Commander. Most of the ones you know are based on silicon, but there are other substances that can form glasses as well. All you need is some substance whose density and other physical properties depend upon the rate at which they are formed."

She changed the slide. "This is Type Two—it's a very dense borosilicate. From the pitting, I suspect that it was part of the outer shell. The only

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strange thing about this type is that every piece I examined has these peculiar flow marks that extend through the entire shell."

Again Simon interrupted. "What do you mean by shell?"

"Right on cue, Commander. Many of the larger samples were layered: Borosilicate on the outside, some alkali-barium beneath that, and something that looks like passivation glass under that.

"Other, smaller fragments had layers of germanium and vitreous silicates. I believe these might have been internal portions, protected by the outer shell, since there's no pitting on their surfaces.

"I haven't figured out how all this fits together, but I can tell you this—this glass wasn't something nature created. More like it was—"

"Manufactured!" Nolan finished her sentence. "I knew it. These things are machines."

Chandra ignored his outburst. "Perhaps. I found something else even more interesting than the grooves in the Type Two material."

Chandra switched to a strange image of mountains and valleys, a landscape punctured by an array of evenly spaced holes. "This is a microscopic view of the Type Three material—that's made of pure silicon, by the way. Each of these holes is precisely the same dimension—about 12 micrometers across. You could shoot a laser through one of them, they're so perfectly straight."

Simon and Nolan were sitting in front of her in rapt attention. Both of them clearly wanted answers she didn't have.

"That's about as much as I've found out. I've been dealing with glasses for over twenty years and I haven't a clue as to how something like this could be constructed. I will say this, however: Whatever made this glass has a technology far beyond ours."

The Ream freighter *M'Lin duBois* slowly climbed out of the quantum hole and reconstituted itself in the region of Dzhou. "Okay, let's get our bearings and fire up the engines," Pel, the captain said tiredly, choking back the taste of bile. Transition was always hard on her. "We've got a long push down to Dzhou. Set the transponder beacon and hail control. Tell them we're coming in."

Before her mate could activate the communications unit, the proximity alarm sounded, indicating an object within five thousand kilometers. "What the devil?" was all she managed to say before the proximity alarm went into the red—whatever activated the alarm was now within a thousand kilometers of the ship and closing fast.

Pel grabbed the comm. "Who the hell are you?" she shouted. There was no response.

"It's stopped." There was no disguising the note of awe in her mate's voice. "It came to a dead stop!"

"Don't be ridiculous," she snapped back. "You can't go from that speed to a dead stop that quickly. Check your instruments."

Her mate just pointed out the small port they used for docking. Framed by the shutters was a misshapen thing of points and crevices. It glowed from within. "I don't think it's one of ours," he added unnecessarily.

Pel stared. The object slowly drifted about what might be its central axis, if it had such a thing. It approached slowly and then backed away before darting off. Pel had not seen it turn.

"Holy mother," her mate said. "She's receding at two thousand kps!"

"Nobody," Pel said slowly after she remembered to breathe, "nobody will ever believe us."

Taylor concentrated the pickets on and near the vectors and distances where the alien ships had either been

seen or encountered. This was a somewhat unbalanced defense shield, but they had to go with the best intelligence they had. The farthest picket was two light-hours away, the nearest, fifteen minutes.

Pride, being the most combat-capable ship, took the center position halfway along the vector between Dzhou and the most distant picket. This placed her nearly two light-hours away from *Honesty*, who protected her right hemisphere, and one from *Integrity*, who took the left.

None of the ships were armed well enough to succeed in a serious battle. *Integrity* was the worst, having been pulled from the ways before her repairs were a third completed. Her drives were functional, her engines, while not up to Fleet standard, were workable. Only one of her guns was operable and, other than a faulty electrical system, no primary generator, and serious doubts about her life support systems, she was able to operate.

Honesty was in better shape, but still wasn't fully up to Fleet standards. Her drive hadn't been calibrated in over a year and her navigation systems were a generation behind *Pride*'s.

"I hate going into this with my legs hobbled and one arm tied behind my back," Kurst complained. "Damn it, just when the God-damned Dzhou premier decides to put out money for decent repairs to *Integrity*, we have to launch. Nice to be operational again, though."

The distant picket ships weren't armed. Given the light-speed delay of any warning they'd provide, the heavily armed ships wouldn't be able to arrive in time to help. The only chance the pickets had was to blink away after they sent the warning.

Otherwise Fleet would arrive to rescue survivors and pick up the pieces.

The first alarm came from a picket about three light-hours away. Thanks to the constant drilling, *Pride* launched

within ninety seconds from disconnect and boost, ample time for a crew on hair-trigger readiness to strap into their battle stations. Due to her location, *Honesty* wouldn't receive the alarm for another hour.

Simon checked the scan even before his stomach stopped clenching from the blink. Navigation had done an excellent job, bringing them out very close to their target. They were within five hundred clicks of the picket *Calcutta*, an obsolete Dzhou transport.

A second later they had visual confirmation. *Calcutta* was lying dark off the dorsal port side. Comm ran the hailing sequence without success: "No lights. No ping. No replies to calls on any of the emergency frequencies, sir" she reported.

"Check for bogies," Simon said unnecessarily. He knew the bridge crew was already looking for any indications that whatever *Calcutta* had encountered was nearby.

"Nothing else within detector range," scans reported.

Not that that meant anything, Simon thought, remembering the speed and maneuverability of that first encounter. "Remain at battle stations," he ordered as *Pride* converged on the disabled ship.

Somewhere down below, a rescue team was being formed, boats were being readied, and not a few members of the crew were praying that this wasn't as bad as it looked.

But Simon had no such illusions. In war a dead ship meant only one thing.

Pilot Han Tomis's *Hotsie* leapt free of *Pride*'s hull and scooted toward the dark ship on wings of steam. They were approaching from the stern, along the starboard side so they could dock near the emergency lock. "Doesn't look like it's damaged," Han observed as he maneuvered the boat to avoid the lighter's outriggers.

"Not from this angle," came the terse

reply from one of the rescue crew he was transporting. "Might be on the other side."

Han leaned forward and glanced toward the bow. Above the hull he noted a dim plume of expanding whiteness—that could be venting snow, but whether from fuel or air it was hard to tell. He hoped it was fuel.

Before Han could brake *Hotsie* sufficiently, his passengers poured out of the hatch and swarmed around the emergency access lock. The engineers had the hatch opened within seconds and, one by one, dropped into *Calcutta's* bowels.

Han gently nudged *Hotsie* as close to the hatch as he dared. Ming floated down and secured a pair of lines to the hull to minimize drift. A flash of light brought his attention to another boat passing overhead. That would be the survey boat making a full bow-to-stern assessment of *Calcutta*. "Any damage?" Han queried before the other boat dropped out of sight behind the lighter's hull.

"Bow's fried," came a quick reply. "Looks like something melted a big hole in it." That wasn't good news for the twenty men in the crew and certainly not for those on the bridge.

Nothing more happened for long minutes. Han could only imagine what they were finding inside the wrecked ship.

Then he noticed movement at the hatch. The crew was coming back to the boat. He watched carefully as they rose from the hatch. The first two wore *Pride's* bright gold suits. Then, three more—all marine engineers from *Pride* and a white medical suit. One more, but none of the suits were the Dzhou Navy blue.

"Whatever hit them burned through the bridge, tore through the crew compartments, and penetrated halfway into the cargo spaces," the marine lieutenant radioed. "I think the engine and drives are salvageable, but the

rest of the ship is a dead loss."

Since neither he nor *Pride* had mentioned casualties, Ming asked, "Any bodies?" Han noted that she'd already rigged the cargo nets for the wounded.

"Just parts," one of the medics replied tersely. "Cooked parts."

One of the marines promptly threw up in his helmet.

Pride's crew was frustrated. Four times they'd responded to emergency calls, finding one ship dead, one that narrowly escaped a similar fate by blinking away in time, and two false alarms.

"I want to catch one of these and show them what a Hellion can do with sufficient warning," Simon told his command crew.

They all did. Every sailor on board wanted to engage the enemy and put an end to their frustrating hit-and-run tactics. But no matter how they rearranged the pickets, no matter how they positioned *Pride*, no matter how they analyzed the few encounters, no one could suggest a strategy that would get them in the right place at the right time.

Simon sat in the officers' wardroom during one of the interminable waiting periods. The bridge was only three steps away—two if he was in a hurry.

"I think they're playing with us," Rear Commander Sterns, his second in command, suggested as he drew a cup of coffee. "Hiding out there, watching us, and then WHAM!" He smacked his palm on the tabletop. "We're dead meat."

"Don't be ridiculous, Hank," Simon replied. "We've got so much overlapping coverage that they'd have to be able to target us from a quarter light-year away—and that's a physical impossibility!"

But Sterns wasn't about to be dissuaded. "If they are bound by physical laws, that is. What if they're not?"

Simon scoffed. "Don't tell me you believe that engine room crap about them being," he intoned in a deep voice, "creatures of another dimension."

"What's so ridiculous about that? Nothing we've seen so far fits the physical laws we're familiar with." Hank ticked off the points on his fingers. "One, they accelerate and decelerate at rates that would destroy any physical creature. Two, they come out of nowhere and disappear just as fast. Three, they don't use any propulsion methods we are familiar with, and, finally, they might have the uncanny ability to track our ships across blink space—something every damn physicist swears is impossible!"

Nolan wandered in and took up the attack. "I still say they're machines, intelligent machines some alien race programmed to track and destroy other races they may encounter.

"Think about it for a minute. Being machines accounts for their ability to withstand the incredible changes in acceleration. As to our inability to detect them, well, maybe they're just too damn small or have too little metal for our scanners to find. Interstellar space is a hell of a big place to hide."

"So your machine's intelligent enough to track us, plot a strategy, and then carry it out? And you call my ideas ridiculous?" Hank was having none of it.

Nolan shrugged. "Honestly, I don't have the faintest idea of how they track us or propel their ships, but it's nothing we know about. I'm a practical man. I believe what I see, not what some physicist says is theoretically possible."

But Hank was still unconvinced. "Yes, and none of the physicists can tell us where we are when we are in blink space either. How do we know if there are creatures living there? Maybe they're just pissed off at us for tearing through the place all the time."

Simon coughed. "The pieces we found are glass, not some strange blink-space material and certainly not fragments of a hypercube. These aliens are just using a different technology, but a technology nevertheless. Once we figure out what that is, we'll be able to deal with them."

The discussion went on after that, generating more heat than light.

Days later, Chandra rose. She was exhausted from reading every report, examining every log, and talking to the people who had actually observed an alien ship. Everything she heard or read confirmed that they attacked with maniacal intensity and without provocation. It was as if the very sight of a Fleet ship enraged them.

That is, except for two freighters who had been completely ignored after encountering the aliens. She peppered Nolan with questions: What had been so different about those two ships? Was it their configuration, their size, or perhaps some peculiar feature of their drives? Could it be a function of whatever they were transmitting at the time?

The only similarity of the two freighter sightings was that both ships were owned by the Polly Propylene line and had followed the same approach vector to Dzhou. According to their ships' specifications they were otherwise dissimilar. Just to be certain she pulled up images of the two ships.

Her jaw dropped in amazement. It was so freaking obvious! Hadn't anyone noticed that both ships wore the distinctive white hull of the PP line instead of the dead black or steel gray of most starships?

No, that was too simple an answer, too obvious. The Ream freighter had been white and that hadn't kept the aliens from attacking. There had to be something else. What was she missing?

Pride received a freighter's pan-

icked report a few days later. "Big freaking ship ran by us. Scared the bejesus out of us, I tell you. Ugly thing, all misshapen, long and skinny, and dark as night, it was. Circled us once or twice and then disappeared. Never saw anything move so freaking fast! What the hell are you Fleet boys playing with, scaring us like that?"

"Think they really saw something?" was Simon's first question. "Or are they blowing smoke?"

"Their description doesn't fit anything we know about," was Nolan's reply. "It might be another kind of alien ship, except ..."

"It didn't blast them to kingdom come. Is that what you're thinking?"

Nolan flipped through his notes. "This makes twelve reports so far. The first two were mistaken identifications. Three were more the product of active imaginations than anything we could find on their scan logs, and four turned out to be panic calls when their proximity alarms sounded from a false return—none of these freighters carry really sophisticated gear, you know.

"In my estimation, it's another scared captain's report. Besides, it's too late to catch whatever they saw and we'll get better information from their logs than a light-delayed conversation."

Simon agreed. At the same time, *Pride's* current position offered an opportunity for a quick look.

Pride made four micro-blinks in rapid succession. The transitions hit Chandra hard, clenching her stomach and filling her throat with bile. The pressure on her temples was immense, preventing her from thinking of anything else except the throbbing pain for a few moments.

When the blinks stopped, she made her way to the bridge. There was no one to stop her. Simon had ordered the crew to remain strapped in, but, since she was a civilian, his rules didn't ap-

ply to her. Besides, she wanted to see what had gotten their attention.

"What the hell are you doing walking around?" Simon snapped before she took two steps onto the bridge. "Strap yourself down before you get yourself killed!"

"That's so ridiculous. The worse that could happen is that I might fall," she answered. She was fed up with his arbitrary rules.

"If *Pride* loses power or has to maneuver, you'll be smashed against the bulkhead. Now strap in, damn it!"

Chandra did as he suggested, although she doubted anything Clay mentioned could really be as serious as he indicated.

"Nothing to report," the woman at the scanning position said.

Then comms shouted, "Captain, *Deliver* spotted one!" Chandra took a second before the name clicked. That was one of their pickets.

"Navigation, fix coordinates. Drives, spin up for combat blink—now!" Simon ordered. "Chief, sound the warning."

Chandra braced herself. She'd heard these combat blinks were rough.

But she was wrong. A combat blink was having your stomach pulled slowly out of your nose. It was having four muscular thugs pounding on your head with mauls. It was feeling all of your organs turning to liquid and flowing out into your pants. It was first worrying that you were going to die, and then fearing that you wouldn't.

It took a precious minute or two for Chandra's thoughts to turn from her physical discomfort to the external world. Judging from the smell, few on the bridge had come through unaffected. "My God!" was all she could say.

"There's *Deliver*!" scans reported. "Jesus, look at that thing!"

Chandra could not make sense of what she was seeing on the visual at first. There was no symmetry she could focus upon. The jumble of

planes and facets broke the image into too many pieces. It glowed with an eerie, pale, internal light.

She focused on the colors; part of it was red and another part shifted more to the blue end of the spectrum. The colors must be a side effect of some other radiation, she concluded, something that scattered the light selectively.

"Take us closer," Clay whispered, as if speaking louder would disturb the alien.

"Standing by to blink," navigation reported.

Simon keyed the comm unit. "*Deliver*, do you need assistance?"

Before the other ship could answer, a pale radiance enveloped the alien and *Deliver*. A plume of silver fire grew between the alien and the ship.

"What's happening?" Chandra screamed.

"The son of a bitch is killing them," someone shouted.

"Why did they fire on it?" she demanded. It was just like the bloodthirsty Fleet to try to attack what they didn't understand.

"*Deliver* is an unarmed picket," Simon shot back. "She couldn't have fired. Oh my God!"

Chandra only had time to catch a glimpse of the alien ship turning its red-tinged spires toward them before the nausea of blink hit her again.

"Object approaching from the stern," scans reported. "Three hundred kps." She paused. "Accelerating."

"Guns, stand by torpedoes," Simon ordered as the approaching object grew to recognizable size.

"It's followed us!" The disbelief was evident in the scan rating's voice.

That's impossible, Chandra thought and, a second later, realized that she was wrong, that all the physics she knew had been wrong, that Fleet had been wrong from the beginning and, as she saw the glowing red foreparts of the approaching alien, that her as-

sumption of a peaceful meeting of the minds with the aliens was beyond the realm of possibility.

"Get us the hell out of here!" she screamed.

Pride blinked again, leaving Chandra completely drained, exhausted, and wishing that her head would just explode and be done with it.

But the alien continued to pursue. "Navigation, give me a plot back to *Deliver*," Simon ordered. When his voice cracked, Chandra realized that the blink toll on him was just as bad. How did he expect *Deliver* to help? She braced herself.

Through the red haze of blink reaction, she saw *Honesty* floating ahead of them, quite close to the corpse of *Deliver*.

"*Honesty*, the alien's on our tail," Simon transmitted. "It's about a minute behind us."

"Shoot the damn thing," Chandra screamed. "Kill it, kill it, kill it, k..." Her words trailed off into mindless terror as the proximity warnings began sounding.

There was a moment of acceleration and then *Pride* spun around just as *Honesty* launched its weapons. Chandra saw the approaching alien screaming after them, heading right for the salvo's spread.

The object suddenly curved away, altering direction so quickly that the torpedoes shot by. No doubt it realized that it was outgunned. *Honesty* and *Deliver* were so close they had probably looked like a single object at first.

But its evasive tactic was not enough. It had turned into the range of *Pride*'s big gun, which fired with deadly precision.

The alien flew apart in an expanding cloud of white splinters. A blue-white pulse of light grew within the cloud and a brief howl of white noise came over the inter-ship link. All the screens glared brightly and then returned to normal.

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Then it was over. The radio crackled as the static diminished in volume. "Thanks for the warning and welcome to the party," *Honesty* transmitted.

"Bridge crew, thanks for the good work," Simon said. He turned to Chandra. "Are you all right?"

She looked up at him. "Did you have to destroy it, Commander?" She was still shaking.

Simon smiled. "I heard you pleading for us to try to communicate with these gentle beings." He didn't even try to hide the sarcasm.

"Even I have limits," Chandra replied with some embarrassment. She was not proud of herself. At the same time she had no regrets, either.

"I need a stiff drink," she said. "Care to join me?"

She desperately needed company.

Simon's face went stone cold. "I've got dead men to recover and reports to file before I can even think about a drink. But feel free to have one without me." He turned away.

Chandra knew when she was dismissed.

Chandra was beside herself with anticipation as the fragments from the destroyed alien ship accumulated in *Pride's* hold. Finally, she had a definitive sample of an entire alien ship, not just random pieces. Now she could start to classify and categorize and, from that, reach some sort of understanding.

Her breath caught as a huge piece, nearly twelve meters across, entered the hold. It barely fit through the lock.

"There's a huge hunk out there," the loadmaster said. "Too big to bring aboard, though."

"I have to see it," she demanded. A larger, intact piece might contain so much more information.

"I don't think you can do that now, ma'am. But don't worry about it getting lost. We put a beacon on it so we could find it later."

The loadmaster was about to say something else, but a stream of curses from his crew drew his attention away. "Anyhow, it's not going to go anywhere now."

Chandra was disappointed, but the large fragment could wait until after she dealt with this treasure trove. As she headed for her lab, she was already laying down her analytical strategies, figuring out what tools she needed first, and wondering what new surprises these shards would offer. This was not only a chance to make a significant leap in their knowledge but probably the greatest jigsaw puzzle she'd ever have the chance to play with!

Taylor and Intelligence boosted out from Dzhou by fast packet to hear what Chandra had learned a few days later.

"First, I think I can answer some of the questions you've had about the aliens," she began. "I'm positive there were no creatures aboard the object. We couldn't find any organic traces among the wreckage. I have to accept that the object has to be a mechanism."

"I knew it!" Nolan exclaimed. "A machine!"

"Why is that, Doctor?" Taylor asked. "It would have to be a pretty sophisticated device to react the way it has."

"It's a matter of volume, Admiral," Chandra answered. "We can estimate the total volume of the object from the scans." Simple it wasn't; she'd had to run four topological modeling tools just to approximate the total volume, and that approximation was still an estimate. But she wasn't about to admit that.

"Based on the estimated volume and the density of the fragments we've collected, I can say for certain that there wouldn't be enough empty space inside to hold a mouse, much less a larger being, even if you put all the voids together."

"Voids, Doctor?"

"Yes, they're the microtubes—the 'grooves' you noted earlier. They run throughout the object."

"But I heard you found some chambers, hollow places throughout the object. Couldn't they be crew spaces?"

"The largest empty spaces we found were near the core and arranged in a symmetrical fashion. If they were crew quarters, then the crew must have been put in there before the ship was formed around them. The only connections to the rest of the object were those microtubes running everywhere."

"Passageways?"

Chandra shook her head. "Only if the creatures were in the sub-millimeter size range. Again, none of the channels penetrated the surface of the object. As I said before, if there was a crew, they'd be completely encased."

She produced a schematic of a spire she had managed to piece together. "See here, it looks as if there's a microtube running up the center with smaller ones radiating from it. They're more numerous at the base than at the tip and diminish in size as they get farther from the large microtube."

"If this piece is from the leading edge of the object," she said slowly, "then these tubes might be waveguides. The size of the larger ones would be operating in the eight to twelve micrometer wavelength, I think."

"I still find it hard to believe in a machine made of glass," Taylor's incredulity was palpable.

Chandra bristled. "Don't underestimate what you can do with glasses," she shot back. "Glasses are a highly versatile substance. Look here . . ." She tapped a nearby fragment. "This outer shell is far superior in strength to *Pride's* armor plating. It's layer upon layer of thin sheets that were formed at extremely low temperatures."

This time it was Nolan's turn to in-

terrupt. "Low temperatures? But don't you need heat, lots of heat, to make glass?"

Chandra replied. "That's a common misconception. No, you can form glass at just about any temperature, given enough pressure and enough time. With our current technology, we could make glass armor like this over a cooling period of about five thousand years or so." She grinned. "As I said, it takes a lot of time, but the strength of glass resulting from cold forming can't be disputed."

"What about those flow lines? Wouldn't they indicate that these might be several million years old?"

"If they were formed naturally, yes. However, those ridges could as easily be an artifact of some industrial process."

"The inner portion of the structure," she continued, "looks as if it's been built up, layer upon layer. Perhaps that is how these ships are built—grown from a nucleus."

"Ridiculous," Nolan barked. "You build machines that big, that complex; you don't grow them!"

Afterward, Chandra found herself considering the alien as if it were an object to be admired. It looked very beautiful and not at all like a deadly enemy that had to be destroyed.

She started at that thought. When had she converted from the sympathetic peace-lover into a fire-breathing killer? Was it her close brush with death that had brought about her change of heart? Was it simply an instinctive fear of the unknown? Or had her earlier anti-Fleet passion been simply a matter of having insufficient facts on which to base her views?

For that matter, did she have all the facts even now? Better to calm down and think than act rashly, she concluded. She needed to learn more about these mysterious aliens before she made up her mind whether they were

friend or foe.

Integrity sat waiting, waiting, and Captain Kurst was growing increasingly impatient. Not only had his crew kept continually busy making repairs that should have been taken care of by those lazy damn Dzhou colonists in the shipyards, but now they had to patch the water lines in their quarters, deal with defective toilets in the aft compartments, and find why the freakin' weapon bays smelled like ten-day-old fish!

Then there were the intermittent power systems. Twice in the last week he'd lost forward scanning positions for over an hour, and don't even bring up the sorry state of the bridge. Half the housings were still lashed to the bulkheads, waiting for fasteners so they could be snapped back on.

Not that he'd needed any of what systems were working. There hadn't been so much as a nibble by the aliens since he started this waiting exercise. Another week in the ways would have at least got the weapons systems up to standard and, just maybe, the toilets as well.

The last three weeks had been a waste of time and budget as far as he was concerned. It was *Pride* that was getting the alerts, *Pride* and *Honesty* that were getting all the glory. Damn. Why couldn't *Integrity* be as lucky?

Three days later, *Integrity* launched immediately after getting an alert. He might be in luck this time, Kurst hoped. The reporting picket's position had been only five light-minutes away.

Scans acquired the target as soon as they emerged from blink. "Target racing toward us, bearing steady, four thousand kps." One of the icebergs appeared on the visuals.

"Engines, turn the ship and give us some boost." He wanted *Integrity* to present the smallest possible target to the oncoming alien.

"Drives, shift blink to my command." He lifted the command switch and let his finger lightly caress its convex surface.

"Guns ready, sir."

"Engines ready."

"No reply to ping, sir."

Kurst's eyes shifted from the scrambled hash of the deep scan to the visuals.

"Decelerating below two thousand kps," scans reported. "Now under fifteen hundred."

Too fast, too damn fast, Kurst thought. It had to be a machine—there was no way any creature could withstand such rapid deceleration. It was the only possible explanation.

Try as he might, Kurst could not find any order to the structure on the visual, no pattern that might indicate functionality or a purposeful plan of construction.

Integrity's hull vibrated from the power of its engines. Kurst liked to keep the ship under weigh so he could maneuver if need be. As long as *Integrity* was in motion, steering engines and mains at the ready, he had options.

"Guns, fire a wide torpedo spread," he ordered. Let's see them dodge those. "Fire a second set two seconds behind." That might confuse whatever defenses they might have enough to score a hit.

The iceberg raced by, veering away to evade the first spread and nearly escaping the second. There was a brief flash as one of the torpedoes struck.

But the iceberg continued moving away, spinning wildly out of a cloud of glistening particles.

"Got him," Kurst said gleefully. "Track and follow."

Engines responded immediately. The iceberg was moving at a steady velocity now. Apparently whatever damage the torpedoes had done affected its ability to accelerate.

"Guns, stand by. Fire as soon as

we're in range." He keyed the command channel. "I want the combat craft deployed when we engage. Maybe we can bring it back for study."

It felt good to be winning for a change.

Teri acknowledged the order to attack and fastened her mask. The hatch sealed as the engine pumps whined to full speed. As she waited for disconnect she ran across the board, checking life support, weapons readiness, engine status and the minutiae of a combat pilot's checklist. She tried to remain calm, but the adrenaline rush was fighting the deliberate, detailed rote the checklist demanded.

Finally, she was done. All she could do now was listen to the command channel and try to figure out what was going on elsewhere in the ship.

The jolt of disconnect as her craft was ejected from the ship came simultaneously with the launch order. As soon as she cleared the hull she saw the big guns firing and, a second later, the glowing spires of the alien.

The visuals had never done justice to how beautiful the alien ship was or how delicate its colors. The sight was breathtaking.

But that was only a passing thought as she accelerated toward the enemy, thumbing her targeting system awake while arming the two torpedoes with her index finger. "Pearl One, Take the right side," command ordered.

Teri veered to the right side, away from where the big guns had struck the iceberg. The side of the alien closest to *Integrity* glowed a bright red and sent a glowing stream past her.

She didn't have time to glance back as she concentrated on her run. Two torpedoes between the largest spires should do some damage, she thought as she identified them in the aiming ring and released them.

She risked a quick glance back as she pulled away and nearly lost con-

trol. *Integrity's* bow was a melted ruin, a gaping hole that vomited people, equipment, and atmosphere in an obscene stream. She didn't need a second look to know that *Integrity* was dead.

She quickly assessed her options. Her combat boat had only limited range and they were well beyond radio range of any other ship. Her life support could only support her for another eight, perhaps nine hours—ten if she slept most of the time.

The iceberg raced away and faded first to a tiny dot, then disappeared, leaving Teri alone with the wreck of *Integrity* and a new appreciation of her own mortality.

Simon was sitting in the wardroom when Chandra stopped by for a fresh cup of tea. He'd just come off duty and was trying to wind down before hitting the sack. He had no interest in talking to her. The last thing he needed at this time was another of her rants about the bloodthirsty military and their abuse of the poor aliens. Since the last, she'd hardly spoken to him.

He was therefore startled when she sat down across from him and smiled. "I still think we have to find some way of letting these aliens know that we got off on the wrong foot and that we are willing to meet them peacefully."

"An excellent suggestion, but just how do you plan on doing that? They seem to be in a shoot-first-and-run-away mode of conversation at present." He was getting increasingly tired of her attitude.

"But there have been two non-confrontational encounters, Simon," Chandra replied. "Doesn't that tell you that they are not necessarily hostile? Every ship they've attacked has been a military vessel. Surely that has not escaped anyone's notice."

"Did you forget about *Calcutta*?"

She shrugged. "Maybe those were mistakes."

Simon shook his head. "The other two freighters' experience hasn't gone unnoticed by Nolan. If he could figure out what it was that kept them from being attacked we could modify our ships the same way."

Chandra drew back. "So you could destroy them easier? Is that what you want?" There was no mistaking the fire in her eyes. Even her close shave with a murderous alien had not changed her core beliefs.

"So we could protect ourselves," Clay said quietly. "Even though we have ample reason to want revenge, our long-range strategy should be to reach some sort of accord. Who knows what technology might result? The promise is too great to pass up." He rose. "Despite what you might think, not everyone in Fleet is a cold-blooded killer. We are warriors, not murderers."

Chandra rose at the same time. "But you did shoot first, didn't you?"

Before he could reply, the wave front of an alert came in. "*Integrity's* on it," Hank reported. "*Honesty* is following."

The reports flowed in hours later. The same weapon they used on *Calcutta* had apparently hit *Integrity*. Everyone aboard had been vented out into the cold vacuum.

What could generate that much power, Chandra wondered? Could it be some sort of electromagnetic effect, a huge lightning bolt? Could it be something akin to a stressed piezoelectric or maybe a capacitive discharge? But how could they do that? What was the mechanism? It was an interesting question and perhaps the answer was among her samples. She could check for some sort of dielectric layer.

There was a disturbance in the corridor. She emerged to see Hank Sterns with his arm around Simon's shoulders. Simon's despair was obvious, from the tears streaming down his

cheeks to the hollow look in his eyes. Strange that he should react so strongly, she thought.

Of course, it must be because of that female pilot on *Integrity*, the rude one.

She put her hand out to Simon. "I'm sorry. Believe me, I am so sorry."

Simon looked at her. She could see the rage in his eyes. "Now do you understand what your damned aliens are doing?" he said. "Now do you see why we have to wipe out these bastards?"

Chandra bit her lip. He was wrong, but this was not the time to point that out. "Is there anything I can do?"

"Yes." His voice was level, chilling in its menace. "Use your so-called expertise to find some flaw in their God-damned glass hides so we can blast them all to hell and back!"

The surveillance beacon they'd left by the huge fragment of the destroyed alien ship sent an alert that something had triggered its sensors. Chandra rushed from a deep slumber to the ops room along with everyone else on the alert list when the signal arrived, hours later. She was pulling her clothes on, just like Simon Clay, a few steps ahead.

The screen showed the fragment slowly tumbling a few kilometers away. At first there was no indication of what had caused the bird to whistle. Then, down at the lower right corner of the screen a white dot appeared.

In a matter of seconds the object became the alien's recognizable shape. "I guess that last burst of white noise was a distress signal," someone murmured behind her. That must be why they had left the beacon, Chandra thought. And here she'd thought it was for scientific reasons. How naïve.

She watched the alien make three slow circuits of the fragment, staying one or two diameters distant the whole time.

"Checking for survivors, do you

think?" Sterns suggested.

When the ship moved closer to the fragment she realized it was considerably smaller than the one that had been destroyed—only about three times the volume of the fragment itself.

The ship bumped the fragment, sending it spinning in a different sense. Then it bumped it again, harder this time. The action reminded Chandra of something she'd seen before, but she could not bring forth the association.

"I think it's trying to signal whoever's trapped inside," Hank continued. "Wonder why there's no rescue squad deployed?"

"There's no crew," Nolan said. "Even if there were, you wouldn't see them at this scale."

"Good point," he said. "Uh-oh."

Chandra turned just in time to see the alien vessel flash away. There were shouts as the ship accelerated from a dead stop and disappeared within a few seconds.

"Well, the SOBs ought to know we can bite as hard as they do," Simon said loudly. "We just have to figure out how to do it more often." When he rose, Chandra noticed that in his haste, he'd forgotten to put on his boots.

"Let's run it a few more times," Sterns suggested. Chandra agreed. Perhaps another viewing would jog her uncooperative memory.

She settled down, giving the action on the big screen her full attention. By the third run-through, she was completely frustrated. Something important was nagging at her, but failed to emerge from the fog. "Why," she asked no one in particular, "was it pushing that fragment around? Isn't the damage obvious?"

"I don't think it's pushing it. See how it barely kisses the surface. It's giving it hardly more than a cute little nudge."

"That's it!" she screamed as the miss-

ing thought that had been bothering her popped into her head. The alien was behaving just like the seal pup she'd seen in Canada—unaware of its mother's death and trying to elicit a response by poking at her body again and again.

"Look, what if we have the wrong idea about these creatures?" she said, dancing around with excitement. "What if they aren't machines or ships from an alien civilization at all?" she asked. "What if they're just animals?"

"Don't be ridiculous. You can't have an animal made of glass," Sterns shot back. "The idea's preposterous."

Chandra bristled. How dare this military idiot call her theory preposterous? "Is it?" she said. "There's a deep-sea animal on Earth that spins glass filaments, and don't mollusks form calcium shells? Surely even you know about the ocean slugs on Europa that armor themselves with an aluminum skin. Those are just three examples from our own little corner of the universe. Who knows what else might be possible out there?"

Sterns stared at her. "Look, all those examples are byproducts of living creatures, not the creature itself. You showed that this is just a huge lump of glass. Don't you need heat to—"

Chandra interrupted. "No, you don't need heat. You *could* build the layers up incrementally if you have enough time and the conditions are right. As I said before, unless the aliens have some technology we haven't discovered yet, it takes millions of years to . . ."

She stopped, overcome by a new thought. "My God, I just realized how *old* these animals could be! Lord, and you've been destroying them without a thought," Chandra accused him. "God damn, but I hate Fleet for starting this!"

"They seem quite capable of protecting themselves," Sterns replied. "Even if they are some sort of animal,

as your wild-assed theory would have it, I'd say the scales were balanced."

Chandra answered immediately. "They're just reacting to what they perceive as a threat. After all, you did shoot at them first."

"They didn't attack two of the freighters," Sterns said. "Nolan's been tearing the remains of his hair out trying to figure out what it was that made them attack."

Chandra fumed. "That's the wrong question. Maybe the right question is what there is about the two freighters that *didn't* trigger an attack."

"You've been doing research, I suppose."

"Damn right I have. At first, I thought the white coloration of the freighters protected them," Chandra said. "But that turned out to be wrong since the white Ream freighter was attacked as well."

"So you were wrong."

She smiled. "Perhaps." She had just thought of another possibility, but she had to spend some time in the library to see if it panned out.

Hours later, she had Simon and Nolan's attention. "Several years ago, the Polly Propylene line thought they could reduce the overall cost of maintenance by putting a thin ceramic coating on their hulls. The idea was that the coating would reflect heat and resist scuffing when they dock."

"Did it work?" Simon asked. He was clearly uninterested.

"It wasn't cost-effective. The added weight increased fuel costs and that offset any maintenance savings. But by the time they realized that, their ceramic hulls had become a ship marque, so they've kept it."

Nolan rubbed the sleep from his eyes. "Oh, I get it. Now you think the aliens think they're some of their own?"

Chandra considered that for a moment. "That's a simple answer, so it's

probably wrong—too many other points of dissimilarity. I doubt the aliens are that unobservant." She paused. "More likely they don't recognize them as something to be attacked because they don't resemble the ship that shot at them." She couldn't help but get a moment's pleasure at Simon's reaction to that barb.

"I also did an analysis of the three attacks you've recorded. In the second and third, one of the ships had the same broken spire pattern. Perhaps it's the same ship."

"So the bastard came back to hit us again. So what?"

She grinned. "I think we've been dealing with only three or four alien ships at most. Hardly the massive invasion force that Fleet may have envisioned."

"So now there are two? The one that hit *Pride* initially and this other one?" Nolan thought for a moment. "Why would the one that hit *Pride* not be with the others?"

"Maybe it's still out there," Chandra said. "And it's wounded so badly the others are protecting it." Just like any animal would protect theirs, she added to herself.

But that presented an opportunity. If they could find the disabled one, they might be able to finally discover exactly what they were dealing with—animal, machine, or intelligent alien beings.

"Animal or machine, we all agree that they seem to focus on a very small volume of space," Simon said. Somehow Chandra couldn't picture a cube light years on a side of any way being "small."

"Let's assume that they have been protecting the damaged ship." He glanced around and caught her frown. "Or wounded, as some would have it. Why don't we concentrate our forces and call them out?"

"A good suggestion, Captain, but the question is where to do that."

"I suggest we concentrate around where *Pride* first encountered the iceberg," Simon said. "Maybe if we could get close to the damaged ship, the other would try to protect it."

"Bring it to us," Nolan chuckled. "Good strategy."

Chandra was infuriated. Simon was using her idea to lure the aliens to their death. Slaughtering animals at worse and imperiling interspecies relationships at best.

Why did it have to be Fleet that first encountered these aliens? Why couldn't it have been some scientific exploration team? Why couldn't it have been someone with an ounce of sense?

The beacon chirped again, two weeks later.

"Combat craft prepare to launch on arrival," Simon ordered. "Guns, stand by. Has *Honesty* launched?" A quick check of her signal showed she was only a few light-instants away.

"Drives activated."

Simon shook his head as the blink nausea passed.

"Target fifty thousand klicks. Speed five thousand kps," scans reported.

"Guns, go to automatic fire," Simon ordered. He didn't want human reactions screwing up this engagement.

Chandra arrived, half dressed and furious. "You can't just kill them," she screamed.

"*Honesty* arriving," comm reported, and, a few seconds later, "Five Light Attack Ships arrived."

"Boats away, Captain," the chief reported.

"Torpedoes launched," weapons reported.

Chandra looked around in confusion. "Simon, you've got to call them off. We can't just kill them out of hand."

"Strap yourself in," Simon ordered. "I don't have time for arguments."

"*Honesty* launched her birds, sir."

"Engines, full burst. I want a huge differential when the guns fire." He could practically feel *Pride* leap forward, eager to do battle.

"Ten klicks." The report came simultaneously with the thump of the big guns firing and the brilliant explosions of the torpedoes that blanked the screens for a fraction of a second.

"Status?" Simon asked. The engagement couldn't have taken longer than half a second, far faster than human senses could process what had taken place.

"No apparent damage, sir. *Honesty* is still functional."

"Torpedoes exploded behind the object," weapons reported.

Simon checked the scans. "*Honesty* didn't do a hell of a lot better. Weapons, set torpedoes so they bracket the target, hit them fore and aft."

Weapons acknowledged. "Second salvo armed, sir."

"And ask *Honesty* to adjust their range. We need to let the bastard run into the round, not try to hit it on the side."

"Target accelerating for a second pass," scans reported. "Swinging to pass on the ventral stern."

The guns couldn't bear on that point until the ship had passed. "Drives, ten-second burn on starboard tubes," Simon ordered, but it was already too late.

"Guns, shoot them in the ass!" he ordered. "Let the torpedoes take the brunt."

"You can't do this!" Chandra screamed uselessly as the bridge crew calmly went about their deadly business.

This time there was a burst of light, a brilliant flash, and a scattering of crystalline fragments immediately after the big guns thumped.

"Got him!" A cheer went up from everyone on the bridge except Chandra. Instead she put her face in her hands and cried.

"*Honesty* reporting, sir," comms said. Byles came on line. "We lost two LAS, Clay. They jumped right into the path of that thing. Slowed it enough for your hit. Just the same, my congratulations."

"They're a good crew, Jack."

"Bloody God-damned killers, you mean," Chandra said. "They should hang the lot of you. You have no idea of what you have done."

Simon looked from her to the expanding cloud of sparkling debris. He had just killed another alien, hopefully the one that had taken Teri. Shouldn't he feel exhilarated at that? Shouldn't he be happy that another of the things had been destroyed?

Instead he felt nothing. Was this an opportunity forever lost? What if Chandra had been right—either about these being animals or being representatives of a race they did not understand? What if that first shot he had fired had been the mistake that resulted in all this death, all this loss, all the horror and sadness of loved ones gone forever?

Had he just done the right thing or not?

Damage control keyed in. "Captain, we've got damage on our starboard dorsal pod. Also lost one generator from that surge. We might have more, but can't tell yet—still checking."

With one pod and its steering jets gone, *Pride* wasn't as maneuverable, but her drive, engines, and weapons still functioned. They were still marginally effective. The lost pod just meant they'd have to call on the tugs to dock them.

"Bring the combat boats back in," he ordered. "Let's start collecting what we can. I think Dr. Sushmarajopori will be very interested in whatever we can find." He looked back to get some acknowledgement from her, but she only glared at him in stony, accusing silence.

"Sir?" scans said. "I've got another re-

turn—distant and stationary."

"Can we get a visual?" Simon asked. "How about pinging it to see if it's one of ours? Could be the picket."

"Negative on the ping, sir. The return's weak, like something was scattering the signal."

Simon keyed the remaining LAS. "Can you take care of my boats? We're going to investigate another return. It doesn't look threatening, but I'd like to make certain that it's not another bogie."

"Good hunting, *Pride*. We'll take care of things back here."

"*Honesty*, can you provide cover? I'd feel a lot better with more firepower behind me." So far they hadn't had much success in singlehandedly confronting the aliens.

"What are you doing?" Chandra grabbed Simon's sleeve. "You can't be thinking of destroying another one!"

Simon didn't answer. There were too many other things to worry about. Unsure of the extent of damage to *Pride*, he'd have to be careful. He wished damage control would give him the final assessment.

"It's the only evidence of intelligent life we've discovered," Chandra was still pleading. "It's like nothing we know. You can't just blast a priceless scientific treasure away because you're afraid of it. Think of what it would mean if we could keep it intact."

"They've already killed too many," Simon shot back, trying to still his own inner doubts. Focus on the mission at hand, he told himself. Concentrate.

He kept his eyes fastened on the visuals. "We have to defend ourselves."

"It might be simply protecting its own," Chandra said quickly. "You'd do the same thing for a shipmate, wouldn't you?"

That got Simon's attention. Not only would he, but he had done so on several occasions. But how could he judge alien behavior based on his own experience? Wouldn't that be projecting

human values on something that was clearly otherwise? No, he had a mission to fulfill. He had an entire planet of people to defend. He had a crew to protect.

But what would Chandra know about such things as honor, pride, and loyalty? All she cared about was proving he was a bloodthirsty warrior, hell-bent on destroying everything in sight. "I'll do what I must," he said simply, trying to believe it.

The image on the visual display displayed a faint glow.

"Appears to be two returns, sir," scans reported. "They're in close formation."

Simon looked carefully, trying to see where the second might be. Going up against a pair of them would be dangerous, even with *Honesty* as backup.

But why couldn't he see the second ship?

Simon ordered guns to prepare. "Arm a wide spread of torpedoes," he added. "We want them to catch the second salvo if they dodge the first."

"You can't do this," Chandra sobbed.

"*Honesty* is two clicks behind us," comms reported.

"Tell him to stand back unless we call for help," Simon said. He didn't want to risk Dzhou's last two warships. Besides, if the aliens used the same passing tactic they'd used every time before, *Honesty* would be in the perfect position to fire on it.

"Engines, let's stand off and see what he does," Simon ordered.

"Lost the second return," scans reported. "I think it's being blanketed by the other one."

"Protecting its own," Chandra insisted.

"Give her a little goose, Engines." *Pride* crept forward, keeping her nose, her big guns, pointed straight at the icebergs.

There was the slightest movement on the visual, as if the object had shifted sideways a fraction. "Guns, hold un-

til my order," Simon said. This was definitely not what he expected.

Now that they were closer, he could see a portion of the hidden object. It was smaller and dim, as if its internal light was fading.

"See if we can get a parallax," Simon said. "I want to see what's between the two of them."

"We've got to get closer if we're going to get any parallax, sir," navigation said. "Its angular rate is about the same as ours."

"Then we'll spiral in," Simon replied.

"Did you get that, *Honesty*?"

"We've got engines going full out," *Honesty* replied. "We're on the end of a long rope out here." That was true; maintaining angular speed to keep pace with the closer *Pride* was going to get harder the closer *Pride* approached.

The iceberg was still shifting, keeping itself between *Pride* and the other ship. It wasn't succeeding, as *Pride*'s angular speed now exceeded its own.

Finally Simon could see into the gap between the two icebergs.

"It looks like a bridge!" Chandra shouted when she saw connection between the icebergs.

"No," Simon replied. "I think it's just where their spires touch."

"No, look how they are rotating. They have to be connected somehow."

Perhaps. Were the two ships exchanging crews, passing data, or was the larger one recharging the other?

"Hold position," he said. "Let's watch and see what they do."

"If they're tied together that makes them vulnerable," *Honesty* suggested.

"Might be a good time to attack."

"Or their combined firepower might be worse than anything we've seen," Simon replied. "I'm going to hold steady and see what develops."

"Looks like the dim one is brightening," the visuals rating said a few minutes later.

"Guns, prepare to fire."

"They let two freighters pass without harm," Chandra whispered.

"When are you going to attack?" *Honesty* asked. "It's a great opportunity."

Simon considered that option. "They've made no overt movement toward us, Captain."

"This is a hell of a time to apply the rules of war, Clay. Attack those damn things!"

"I don't shoot sitting ducks, Captain," Simon replied instantly.

As soon as the words were out of his mouth he regretted them. It had been a stupid thing to say. These were the aliens who'd killed so many people. These were the things that took Teri's life. These were inhuman aliens hell-bent on destroying humanity. These icebergs had the potential to destroy *Pride*.

But something wouldn't let him give the order.

"I'm detecting proper movement, sir," scans reported. The pair was moving at an oblique angle to the *Pride-Honesty* vector.

"They're accelerating," scans reported.

"*Pride*, intercept them!" *Honesty* said. "Don't let them get away."

"Engines, turn on their vector," Simon ordered.

"One hundred kps," scans reported on the targets. "They're opening the lead."

"Engines, give me all you have," Simon ordered, even though he knew the boost wouldn't be sufficient. Given the alien's acceleration characteristics, there was no way *Pride* could catch them, not in her present condition. "What's the vector?"

Navigation took a few seconds before responding. "Sir, they're heading toward Dzhou."

"Prepare for combat blink," Simon ordered at once. His options just disappeared. *Pride* and *Honesty* were the only warships capable of defending

the planet. They had to get home and in some sort of defensive position before the alien ships arrived.

"Distance and bearing, sir?"

There was only one choice and that was to get to Dzhou ahead of the aliens. But a single long-range blink was risky, and doubly dangerous for the crew. A blink of that distance gave *Pride* only a seventy percent chance of surviving. It was dangerous, even in the tightest combat situation.

Even if *Pride* did make the blink successfully, he'd probably lose half the crew's effectiveness. There was also a high probability of a few deaths.

Simon keyed Sterns. "Hank, can you get your crew up to the bridge? Maybe enough crew will remain effective enough to fight after we blink."

"Just how far . . ." Hank began and then stopped. "Right away, sir." He knew better than to bother command with idle questions:

"Set our course for home," Simon told navigation. "Drives, tell me when we have enough spin. Comms, tell *Honesty* our intentions."

"What's the problem?" Chandra said. "Simon, what are you doing?"

"I think the aliens are going to attack Dzhou," he said. "We're going back there to stop them." Then he added, more gently. "I'd advise you to strap down. This is going to be rough."

"Drives at spin, sir"

Simon didn't hesitate. "Blink."

"Blink." Chandra heard the words and then the world, the entire universe collapsed in on her. She felt as if her entire body were being squeezed through a hole half a centimeter in diameter, as if her stomach was forced into her mouth, as if all the blood and fluids in her body were pushed into the space behind her eyes, as if there was a tightening clamp around every single muscle. She thought she would pass out, but was afraid that she wouldn't. Her vision blurred. Every-

thing was smeared with red, red, red.

And then she exploded. She felt the hot rush of shit filling her pants, the acid taste of bile as she emptied the contents of her stomach into her lap.

Then it was over and she realized that she was not alone in her discomfort. One of the crew was flopping and twitching in his seat. Others were sitting slack-jawed at position. Those who could still move were quickly pulling the weaker from their positions and taking their place. Nobody was caring for the crew the others had cast aside.

She unclipped her harness, knelt beside the epileptic crewman, and forced a wad of fabric between his teeth. Then she rolled the man beside her over to his side to keep him from choking on his own vomit. And then there was one more who, she realized as he touched him, was not breathing. No pulse, either. "We need a medic," she screamed.

Simon was otherwise occupied. Hank had taken over guns and two of his effectives had replaced scans and navigation. "Comms, see if you can raise *Honesty*," Simon ordered.

An agonizing twenty minutes later he heard *Honesty*'s response. "We had to take a three-hop blink," the reply started. "Drives are barely operational now and only three-quarters of my crew are still effective. We're going to stand off about five hundred million clicks from you with drives spun up for microblink as soon as we see the targets."

Simon keyed an acknowledgement. It was useless to try to coordinate in real time over that distance. "What's the situation?" he asked damage control.

"Crew came through pretty well. All stations are combat-ready. We're moving the worst cases to quarters, medical if necessary."

"The ship, damn it. What's the situa-

tion with the ship?"

"Still checking, sir. We thought the crew..."

"The crew isn't that important at the moment. I need to know whether *Pride* can still fight or not. Get me that answer!" he said angrily.

Then he looked around. Two of the disabled were groggily sitting up. One was squirming around strangely and the other lay still and quiet beside a crying Chandra.

"Incoming two thousand kps!" scans shouted.

Simon glanced up. "Guns, on my order."

"You can't do this," Chandra insisted, pleaded, cried.

"Vector's changing, sir," scans said.

"Coming into range," Hank said steadily. "Torpedoes ready."

Simon watched the plot. If the aliens continued their present course they would pass Dzhou entirely. "Where the devil are they heading?" he asked.

"Vector's toward the sun," navigation replied at once.

"Accelerating, five thousand kps."

"In range now," Hank said. "Shall I fire?"

"Guns, hold," Simon said. "Are they still accelerating?"

"Yes, sir. Now passing seven thousand and climbing." Even with an inertialess drive, they couldn't possibly change their course toward Dzhou, not with all that momentum built up.

"Out of range," guns reported.

"Holy shit! They've disappeared," scans exclaimed. "Hold, I've got a flash signature. Looks like they blinked, sir. It's small, though—probably a thirty-second microblink or less. Sir, it looks like they're heading into the sun!"

"Death before dishonor," Simon said with admiration.

"Perhaps," Chandra said quietly. There was another possibility, one that she would have to confirm after she went through the fragments in the hold once more. Maybe there was an-

other reason for their action.

Taylor paced back and forth in his office. The post-threat assessment spoke volumes about Dzhou's cost for failing to respond quickly to the alien threat. One frigate and crew lost; three or four LAS destroyed, along with their crews; as well as two freighters. If the ships had been better prepared or had been deployed earlier, they might have gotten all of the alien ships instead of just the two.

But he couldn't fault Tu'un or his government alone. The Fleet was equally to blame for sending such poorly maintained ships to deal with the invasion.

He was not entirely blameless either. Hadn't he brought Simon Clay back and given him command of *Pride*? And Simon hadn't fired on the aliens when he had the chance. Twice he missed an opportunity to end this threat once and for all, and twice he failed to act.

Damn, how could his judgment of an officer have been so wrong?

Chandra waited until Simon left the ceremony before she approached him. "I watched the award ceremony. I guess you're pretty proud of your medals."

"Not when I think of the cost," he replied. "There were too many dead people, too many shipmates and friends lost. No, I take no pleasure in medals."

"Nevertheless I imagine you'll get a promotion out of this."

Simon shrugged. "I doubt it. The admiral's asked for my resignation. That's not all bad. I need to get away from here, from reminders of too many damn things that might have happened." An expression of deep sadness passed across his face. "Any place different will be a relief after the hell I've been through."

"I doubt Fleet will let you do some-

thing like that, Simon. Although I hate to admit it, you appear to be very good at what you do."

"Taylor didn't think so. Wrote a scathing report about my failure to act. All but called me a coward for not firing on the last two alien ships."

Chandra caught herself. "I wondered about that myself. Why didn't you fire, Simon? Why did you let the two of them go?"

"That's a good question and one I can't really answer. Lord knows I had good reason to destroy them, and the firepower to do it."

"But you didn't."

"No, I think I suddenly saw something very human in what the aliens were doing."

"What are you saying? I can't believe you had a sudden irrational surge of sympathy. That doesn't sound much like a warrior to me." A smile played around Chandra's lips, half teasing, half serious. "What about when they approached Dzhou? Why didn't you fire then?"

"They weren't heading for Dzhou. They were just trying to escape."

That admission rocked Chandra back. "But you reported that you didn't want to chance confronting them without knowing *Pride*'s condition."

"Made a nice story, didn't it?" Simon said bitterly. "Taylor bought it, as did the rest of command. At least that's the story they'll send back to Fleet headquarters."

"I clearly heard you say something about suicide, about taking the honorable way out."

"Well, maybe that's what they were doing. Who knows?"

"I knew it!" Chandra put her face close to his. "You finally understood that they were just animals, didn't you? You realized that I was right!"

Simon didn't respond immediately. "Maybe I believed your theory, at least a little. And maybe I also believe that they were machines, giving no

thought to the havoc they caused. Or maybe I felt a bond with any ship trying to save another. As I said, I don't shoot sitting ducks. Leave it at that. Thanks for listening."

Chandra held him back for a moment. "Listen, Clay, what you did was right. I checked the thermal flow lines on those large intact fragments. Did you know they all flow in one direction, as if the object had passed through intense heat?"

"Like passing through the sun?" he said.

"Exactly," she replied.

Clay smiled. "Like the phoenix." Then he turned and walked toward his lonely, uncertain future.

Tu'un had a new fish, a darting black torpedo that moved with near invisibility through the grasses in the bottom of the tank. "So, do you think we are rid of the aliens at last?"

Schwen Wei stood beside him. As far as he was concerned, the premier's new fish was too small for eating and too big for bait, not that he would ever hint at such an idea to his friend. "One of our prospecting ships detected two bright objects moving away from the sun at an impossibly high rate of acceleration before they blinked out of the system. The assumption was that it was a Fleet maneuver."

"You suspect the aliens were not, as Fleet believes, destroyed when they dove into the sun?"

"I believe that the aliens who so harried us are gone," Schwen Wei answered.

Tu'un raised an eyebrow. "That is an ambiguous answer. Perhaps you would explain."

Schwen Wei hesitated. The premier had been reluctant to believe the first report of the alien craft, an innate skepticism that served him well in the political arena, but could work against him when a real threat appeared. Would he reject what Schwen Wei was

about to say out of hand, or react with laughter?

"You heard the conflicting theories about the aliens," he began. Tu'un cocked an eyebrow to acknowledge that he had. "Some thought they were ships full of microscopic aliens. Others suggested they were machines, hell-raising devices launched by an inimical alien race against any rivals. Then there was the idea that these might be incredibly ancient animals, evolved over billions of years to their present form."

"Animals, you say? How interesting." Tu'un's answer was guarded, as if he had already detected a hint of what Schwen Wei was about to propose. He dropped a few specks of feed into the tank. The white flakes drifted slowly downward.

"They were animals," Schwen Wei insisted. "They used the same tactics every time, seemingly learning nothing from their earlier attacks. I believe they developed that behavior for a reason, just as every function evolves to help feed, reproduce, or defend any natural creature."

He had Tu'un's full attention now. "We must now ask ourselves what sort of threat caused these animals to develop those behaviors, those defenses."

Schwen Wei paused, partly for dramatic effect, but mostly because he wanted the implications of what he was about to say to have the maximum impact.

"I believe that whatever creature preys on these things must look a lot like our starships."

Tu'un's dark new fish darted from the grass and attacked the grains, consuming them one by one. ■

(EDITOR'S NOTE: This story is a sequel to "Clay's Pride," in our July/August 2004 issue.)

THE REFERENCE LIBRARY Tom Easton

The Carpet Makers, Andreas Eschbach, *trans.* Dory L. Jensen, Tor, \$24.95, 300 pp. (ISBN: 0-765-30593-3).

Buried Deep, Kristine Kathryn Rusch, Roc, \$6.99, 373 pp. (ISBN: 0-451-46021-9).

Paradise Passed, Jerry Oltion, Wheatland Press, \$19.95, 310 pp. (ISBN: 0-9755903-2-4).

When the Beast Ravens, E. Rose Sabin, Tor, \$23.95, 287 pp. (ISBN: 0-765-30858-4).

Saint Vidicon to the Rescue, Christopher Stasheff, Ace, \$6.99, 308 pp. (ISBN: 0-441-01271-X).

George Alec Effinger Live! From Planet Earth, Marty Halpern, ed., Golden Gryphon Press, \$25.95, 365 + x pp. (ISBN: 1-930846-32-0).

Attack of the Jazz Giants and Other Stories, Gregory Frost, Golden Gryphon Press, \$25.95, 344 + x pp. (ISBN: 1-930846-34-7).

Atlanta Nights, Travis Tea, <http://www.lulu.com/travis-tea>, \$11.94, 300 pp. (ISBN: 1-4116-2298-7).

Five Quarts: A Personal and Natural History of Blood, Bill Hayes, Ballantine, \$23.95, 291 pp. (ISBN: 0-345-45687-4).

We can thank Orson Scott Card for visiting an SF con in France, where he first heard about German writer Andreas Eschbach, met him, obtained a sample of his work (in German, which Card doesn't read), and induced friend Doryl Jensen to translate a bit. The result blew Card away, blew his Tor editor away, and as soon as you rush out to find a copy of Eschbach's first novel (1996), **The Carpet Makers**, will blow you away too.

Yes, it's that good. Jensen does a superlative translation that lets Eschbach's voice come through in all its glory, and that voice is as original as you have heard in SF in many years. As Card says, Eschbach has vision, compassion, and senses of tragedy, character, spectacle, and human possibility and inevitability. There is as well a sense of what science fiction can be when it stops trying to im-

itate films and TV shows and last year's bestsellers.

The premise is fairly simple: A world where carpet makers dedicate their lives to knotting a single carpet from the hairs of their wives and daughters (the curly ones from their armpits are used to bind the edges). They live on the proceeds of their father's carpet, and when they finally complete theirs, the proceeds will go to their one son (they are allowed only one; any additional must die), who will take up the task in turn. Every so often a trader's caravan arrives in town to collect the carpets in a huge armored wagon. When it completes its route, the carpets are transhipped to a starship, which takes the carpets away to decorate the Emperor's palace, the largest and most glorious palace in the universe.

So it has been for generation upon generation. But there are rumors that

the Emperor is dead, deposed. Since the Emperor is believed to be immortal—and he has in fact been Emperor for many thousands of years—the rumors are regarded as heresy, sacrilege. Those who repeat them are killed.

But a rebel arrives, scouting out the world, telling folks that indeed the Emperor has been dead for twenty years and reporting back on the carpets. All does not go well for him, but other rebels soon discover that the carpets are also made on other worlds—thousands of them!—in a zone of space left off the Empire's charts. Furthermore, the Imperial Palace is quite devoid of carpets.

The puzzle proves absorbing to the rebels. Eschbach's tale is the unraveling of the mystery, and he is clever, insightful, entertaining, and satisfying. He avoids red herrings, he drops clues such as the Emperor's reputation for eternal vengeance, and when he finally draws back the curtain we are as astonished as any mystery writer would love us to be but very, very rarely achieves.

I hope that Tor will have more of Eschbach's work translated. If they don't, I suspect that many dedicated fans will learn German just so they can read *Solarstation* and *Jesus Video*, which have already won top German awards. Or they could look for translations into tongues they already read, such as French, Italian, Czech, Japanese, Russian, and Turkish.

If you don't get it, this one has my highest possible recommendation.

In the future of Kristine Kathryn Rusch's "Retrieval Artist" series (which began with an *Analog* story, "The Retrieval Artist"), humanity has forged treaties with a number of alien societies, agreeing that if humans offend against alien laws, on alien turf, they are subject to those laws. Ignorance of the law is no excuse, and if penalties seem draconian or bizarre, that's just too bad. So there are "disappearance agencies," which will, for a fee, help one leave an old

identity behind—career, money, property, name, loved ones, history, and all—in order to start afresh, presumably beyond the reach of alien justice. There are also Retrieval Artists, who seek the disappeared when legacies or other important matters arise. One such is ex-cop Miles Flint, the central character of the series.

But in the latest, **Buried Deep**, we don't see Flint for a while. The tale begins on Mars, currently dominated by the Disty, thoroughly strange creatures who live in warrens, perform astonishingly violent vengeance killings, and feel contaminated when in the presence of a dead body—or of someone who was anywhere near the body, or of someone who talked to someone . . . At the moment they're upset because in the course of an excavation, workers found a human skeleton. That's enough for the neighbors to move out while human investigators, including a forensic anthropologist from Earth, get called in. When the pathologist discovers from bone scars that the dead woman had had children, the Disty are excited. If the children can be found, the Disty will be able to decontaminate the scene without hurting anyone. If the children cannot be found, it will get messy. So the anthropologist gets to go to the Moon to look for a Retrieval Artist to find the kids.

Meanwhile, the Disty desperately want to be reassured that there are no more bodies. So the human investigators are digging further. That's when they find the mass grave.

That's also when the Disty flee the city, a panicked rout that spreads to other Martian cities. When the Disty start trying to escape the planet, it also leads to crashing spaceships and a flood of refugees heading anywhere but Mars.

Meanwhile, Miles' old partner Noelle DeRicci has just been put in charge of the Moon's security. She has no real power to do anything, and certainly no power to enforce any proclamations she

might make, but when she realizes the Disty refugees are on the way and learns that the panic will spread to the Moon's sizable Disty population, she closes the ports. This is much to the venomous joy of the reporter who is trying to bring her down.

Meanwhile, Miles is doing what he does best: investigation, research, tracking the bones, linking them to the mass grave and unpleasant history. Rusch drops enough hints to let the reader see what's coming a bit before she gets there, but her future world is as real and as gritty as ever. If you have met this series before, you won't want to miss this installment. If you haven't, you have a treat in store, as well as three previous books to catch up on.

Jerry Olton may be best known here for his short fiction, but he also writes SF novels (with several Star Trek books on his vita). Alas, not all his novels have appealed to the major New York publishers. One such—which he calls his favorite—he wound up taking to Wheatland Press, a small operation in Wilsonville, Oregon, which he says he found it a pleasure to deal with. The result is **Paradise Passed**, a quite competent tale of exploration and choices. The protagonist, Ryan, has grown up on a colony ship on the way to Alpha Centauri. The crew isn't sure what awaits them, but they are drawing near and Ryan's friend David has just recorded definite spectral indications of breathable atmosphere on two planets. Unfortunately, at that very moment, Ryan's dad Ken is sacrificing a goat to persuade God to put a suitable world in front of them. Since Ken has been preaching a bizarre sort of fundamentalism for awhile, Ryan and David immediately conclude that he will claim David's spectra prove the power of the sacrifice and hence the truth of religion.

Sheesh! Well, maybe, but . . . The first world is quite Edenic; in fact Ken insists it *is* Eden, even unto the intelli-

gent natives whose six tentacles make them suitable stand-ins for the snake. Ryan and a few others think the colonists should refrain from interfering with the development of a potential local civilization and should therefore go look at the second world. In due time they prevail, and that expedition finds a much more dangerous—and interesting—place with no apparent natives. Ryan and friends think this world better for colonization. Others think Eden is quite appealing. There is debate, and a vote, and . . .

There's a bit of romance. Ryan is sweet on Holly, who thinks of him as a friend. Kristy wants him, and he thinks that though she is sweet and sexy enough, her main appeal is that she wants him. This poses a bit of a problem for Ryan's characterization, for Olton insists he is the quintessential "nice guy," but the problem does not become acute till near the end.

Since Ryan is young, still groping for a position in life, *Paradise Passed* has the feel of a young adult novel. The romantic dilemma gets slightly explicit at times, and the resolution is a bit crass. This may have made the New York publishers who didn't want the book feel that it fell too much in the cracks, neither one thing nor another, and was thus too difficult to market.

But it's worth marketing. It's a pleasant read, a bit uncomplicated for experienced SF readers, but quite suitable for older young adults.

E. Rose Sabin's **When the Beast Ravens** is the third in a series, sequel to *A School for Sorcery*. As the titles suggest, her tales echo the wildly popular Harry Potter novels, and the comparison is prominent on the cover. But though the Simonton School for the Magically Gifted has some remarkable hyperdimensional extensions, it lacks the enchantment of Hogwarts. So do the characters, for Gray Becq, after surviving previous perilous adventures, has re-

turned for a new term full of anger and jealousy. What he finds is a school preoccupied with petty thefts, a room shredded as if by his were-panther schoolmate Lina, and a succession of dead students.

What is going on? The Headmistress thinks that Becq has somehow become a conduit for demons, but perhaps something else is going on as well, or instead. It is up to Becq and his friends, even his one-time foes, to master their powers and feelings and conquer the demons without and within.

It's much darker than Potter, but it's still a nice allegory of adolescence. Parents be warned, though: The darkness makes this one less suitable for kids and more suitable for teens.

Christopher Stasheff created Saint Vidicon over two decades ago as a monk-engineer who used his own body to replace a failed resistor and keep the Pope on the air long enough to bring the world back to the Church. The experience was a little hard on the monk, for he promptly found himself facing the mouth of hell. But he was also—as a saint—receiving loads of prayers for help in humanity's war against Finagle and his minions, Murphy, gremlins, gremlins, and so on. Needing help, he managed to enlist computer troubleshooter Tony Ricci as a sidekick, rewarding the geeky fellow with a little romantic assistance.

Of course, if you're the sidekick of a Catholic saint, you ain't *never* gonna get laid! But Tony still makes progress in between his adventures warding off Finagle etc. **Saint Vidicon to the Rescue** is fun, especially for Stasheff fans. *Analog* readers who haven't encountered this writer's brand of humor will find it a nice fast-reading introduction.

Marty Halpern had a nifty brainstorm for **George Alec Effinger Live! From Planet Earth**. He asked friends of Effinger's—Mike Resnick, Howard Waldrop,

Neil Gaiman, and more—to name their favorite stories and write a few words about them. The result is twenty-two of Effinger's best, including the eight previously uncollected "O. Niemand" stories (introduced as a group by Gardner Dozois).

Effinger died in 2002, but he has not been forgotten. This is the book to show you why.

Gregory Frost gets the Golden Gryphon treatment with **Attack of the Jazz Giants and Other Stories**, which brings you a brand-new novella, "The Road to Recovery," with echoes of Hope, Crosby, and Flash Gordon. You can also discover "The Girlfriends of Dorian Gray," as well as a dozen more.

A sad truth about the publishing industry is that not everyone who wants to be published can possibly get published. Not only do book publishers and magazines receive more submissions than they can possibly publish, but when their staffs start looking through the pile of possibilities delivered by the mail (a.k.a. the "slush" pile), they find that most are utter dreck. If anyone published them, no one would buy them. Well, maybe the author's mother, except that the author of course could be counted on to buy a few copies for Mom, Grandma, Sis, Aunt Betsy, and so on.

So the staff sends out rejection slips—sometimes polite, sometimes less so, but never as frank as the staff dreams of daring to send—by the basketful. And the hopeful wannabe slinks home to hide under the bed.

Well, not really, for there are many outfits out there that take a less critical view of the manuscripts that come their way. Vanity publishers will publish almost anything—for a price. Scam publishers tell their prey that real publishers (see paragraph 1 above) are a conspiracy designed to protect the interests of an elitist in-group and bar the doors of

critical and financial success to everyone else. They say, pointing to the vanity press that the suckers are already familiar with, that *everyone* pays to get published. Then they add that published writers are really pretty bad, certainly much worse than the suckers.

PublishAmerica attacked professional, published science fiction authors, saying that "As a rule of thumb, the quality bar for sci-fi and fantasy is a lot lower than for all other fiction. . . . [Science fiction authors] have no clue about what it is to write real-life stories, and how to find them a home." They are "writers who erroneously believe that SciFi, because it is set in a distant future, does not require believable storylines, or that Fantasy, because it is set in conditions that have never existed, does not need believable, every-day characters."

PublishAmerica claims to be a real publisher. It does not ask writers to pay to see their books in print. It actually pays them an advance on royalties (just a buck, but the principle is there). Then it prices books high, asks authors for a list of friends and relations to send "Buy me!" pitches to, and tells the writer it's up to him or her to actually peddle the book. Bookstores refuse to carry PublishAmerica products.

Are they truly a "real" publisher? Since one of the distinguishing marks of a real publisher is selectivity (they take the considerable trouble to look at submissions and pick out the ones that they think have a chance to succeed in the market), a number of science fiction and fantasy writers (hereinafter "the crew") got together last year to write the very worst book they possibly could. Every chapter is by a different writer. One chapter is computer-generated garbage. Characters change names, moods, hair colors, races, genders, and motivations even *before* the hat drops. It is so bad that a blogger later said: "It's so bad it hurts. Your brain tells you to stop reading, but you can't take your eyes off it." It's worse than the infamous *Eye of Ar-*

gon.

Then they submitted it to PublishAmerica.

PublishAmerica, as if it were trying to prove itself as much a scam publisher as anyone had ever called it, promptly issued a contract. The accompanying letter said, "I am happy to inform you that PublishAmerica has decided to give 'Atlanta Nights' the chance it deserves. . . . Welcome to PublishAmerica, and congratulations on what promises to be an exciting time ahead."

The crew promptly started crowing. As soon as PublishAmerica heard, they withdrew the contract, saying that when their editors looked at the manuscript, they saw problems. That is, they did *not* look at the manuscript before issuing the contract.

But the crew wasn't done. **Atlanta Nights**, by Travis Tea (say it out loud), is available as a trade paperback from www.lulu.com (and as a free download from www.embiid.com), where publication is free (so is the preview). It would make the perfect gift for someone you suspect of never reading the books you give them. It would—nay, will surely—be the basis of a fannish parlor game called "Who wrote this chapter?" And even though I provided a cover blurb ("Unbelievable! Incredible! A real jaw-dropper!"), it is bad, bad, bad—so bad you have to see it to believe it.

Who's in the crew? Here are the names of the guilty: Michael Armstrong, Pierce Askegren, Andrew Burt, James D. Macdonald, Sherwood Smith, Adam-Troy Castro, Judi B. Castro, Mary Catelli, Brenda Clough, Shira Daemon, Sheila Finch, Charles Coleman Finlay, Sean P. Fodera, Peter Heck, M. Turville Heitz, Deanna Hoak, Ken Houghton, Tina Kuzminski, Ted Kuzminski, Megan Lindholm and Robin Hobb, Paul Melko, Catherine Mintz, Derryl Murphy, Vera Nazarian, Kevin O'Donnell, Jr., Chuck Rothman, Jena Snyder, Allen Steele, Victoria Strauss, Laura J. Underwood, Brook West, Danica West, Julia West, and

Rowan West.

What they did has no chance at all of stopping the depredations of the scam publishers of the world, but at least they had a great deal of fun in trying. And perhaps the publicity will warn off a few potential victims of the scammers.

Bill Hayes' previous book, *Sleep Demons*, dealt with insomnia, as seen through the lens of his own. That is, he has shown a tendency to choose topics that have a personal connection, both to himself and to a great many other people. (Who has not at least on occasion had trouble falling asleep?) This is an approach that has immense potential, for candidate topics include aching backs, fallen arches, sore teeth, thinning hair, arthritis, asthma . . . Anything but pregnancy, menarche, menopause . . . If Hayes has it, and if he's not alone, it's fair game.

Okay, I'm playing cute. I have no idea whether Hayes has an aching back, etc. Even the thinning hair is a mystery, for according to the flap photo, he shaves his head. But here's his next book, *Five Quarts: A Personal and Natural History of Blood*, and it fits. He has it, if you cut him, he bleeds, and his partner has AIDS. Blood is of more than ordinary concern to all of us, and of extraordinary concern to far too many of us. And

in the service of this concern, Hayes goes back to mythology to address the psychological potency of the red fluid, covers the history of our understanding and of medical practice, and expresses a very tender concern for his partner and those who share his condition, as well as those with less infectious blood disorders (such as hemophilia). He reflects on the curious change in perception, that now blood is seen as a biohazard. He covers bleeding, once a standard medical practice, and the development of the techniques that lie behind a blood count. He visits a blood bank to explain what happens to donations. He explains AIDS and hemophilia and even "hemophilia" (the very rare woman with hemophilia). He simplifies, but rarely too much, and he errs egregiously only once (growth hormone is secreted by the pituitary, not the pineal, gland).

If you think blood is pretty yucky stuff, this is the book to give it a human feel. If you have so far refused to be a blood donor, this book may convince you to change your attitude. If you think the victims of AIDS and hemophilia and other illnesses are not quite human, or are being punished by the gods, well, this book won't change your mind (though I wish it could). The rest of you have a treat in store, and so does any biology student you choose to gift. ■

READERS: If you are having problems finding *Analog Science Fiction and Fact* at your favorite retailer, we want to help. First let the store manager know that you want the store to carry *Analog*. Then send us a letter or postcard telling us the full name and address of the store (with street name and number, if possible). Write to us at: Analog Science Fiction, Dept. NS, 6 Prowitt St., Norwalk, CT 06855-1220. Thank you!

Dear Stanley,
After twenty-six years of reading your editorials, I feel we should be on a first name basis. Besides, you never use any other signature than Editor, though it probably should be Doctor.

We, sir, are both celebrating our 75th anniversary with *Astounding/Analog*. I first encountered it in my piano teacher's waiting room, which must have been when I was thirteen, and I am sure that I took lessons for two years after I couldn't have cared less, just to be able to read it in his waiting room. My mother thought science fiction was a waste of reading time, so I read it by flashlight under the bed covers, or, as my sister reminds me, in the bathroom where we threw it into the hamper when mother was cruising. I don't remember how far back it was before I could afford the time or money to start a regular subscription, but if you keep records, it is pretty far back. Once started, I don't think I have wittingly discarded an issue, and have decades worth double stacked in a bookcase in my cellar. I have no idea if any of these have value as collector's items now, but they sure go back to Weinbaum, Padgett, Asimov, Heinlein, Clark, Anderson, you name them. I collected McCaffrey's Përn series and still have them and many others she wrote as novels. And I morphed with the journal through all of its names. I think *Astounding Stories* is its best,

and mourned the various changes, but read and enjoy the fact section of each issue.

One problem is that I find many of the latter year's science fiction stories less science than stories, and not even good fiction, in some cases. Recently there has been a better crop, with credible themes, but I don't any longer find things that I have read about happening, as when the first atom bomb hit the news, and I found myself saying, "Finally." I was waiting years for it to happen. Currently, I am in catch up, as I have put *Analog* aside, giving priority in reading to *Scientific American*, *Smithsonian*, and *National Geographic* (and of course my medical journals, in a never ending and critical stream). But given the practice of never going to sleep without doing some reading, I'm now giving priority to getting 2004 retired before I accumulate 2005. The problem is now, with popularization of science reporting, access to science reading is easier than ever, and fact has long become stranger than fiction. Astonishingly, *The Wall Street Journal* can be a source.

I enjoyed your editorial in the January/February 2005 issue, and finally was impelled to write the letter I didn't on the 50th or 70th anniversaries. I hope you can keep writers with real imagination, backed by real science—even better, by new or novel science—in your lists. The places they

can go now, with real probability, are the stars. Populations do not need to be carbon based or oxygen supported anymore. The realities of the extraordinary existences tolerated by the extremophiles, in our bacterial worlds, broadens the scope of life as it could develop elsewhere, and the growing awareness of planets other than ours, likewise. Social alternates to our variety—alternate civilizations—beckon, as do variations on the industrial revolutions, and legal and capital fantasy. But spare me the hokey or jokey. I won't live to see your centennial, but I hope you might, and love it.

Best to you, yours, and *Analog*,
Doris J. W. Escher
Scarsdale, N.Y.

Dear Dr. Schmidt:

[Regarding the March 2005 editorial:]

The elder members of my New England Yankee family habitually quoted pithy sayings, which, upon analysis, often turned out to be pure information.

One of my grandmothers often remarked that, "If you want to be healthy, eat some of everything in its season." She included every food grown in the area, and all those available in our local stores. She expected her family to eat what was put before them.

She justified her advice by saying that the Lord had created us for the earth and the earth for us, and therefore what He provided to eat was what we should eat, which sounds like what the ecologists tell us. Either way, it includes fresh spring greens, all the summer fruits and vegetables, and autumn and winter root vegetables.

She lived near the ocean and never lived where chicken was not a staple food, so her menus included a lot of both chicken and seafood. She blithely assumed that citrus fruits were "in season" when they could be safely

shipped all the way from Florida.

She also believed that "some" meant a proportionate amount of what there was. If there were bushels of beans and corn, then a huge pot of succotash was served. When peaches arrived at the doorstep by the bushel, there was no reason not to have peach shortcake, all you could eat and nothing else, for supper. Such meals were our special treats.

When I find that the eggs which were forbidden to healthy diets a few years back are now considered perfectly good food, ditto the butter, shrimp, and other foods now back in good repute, it seems the better part of wisdom to ignore the off-again, on-again diet news and go back to the Old Lady advice, eating the in-season foods when they are at their nutritional best.

Yours for good eating,
Lois B. Schultz
Mokena, IL

Hi Dr. Schmidt,

In your March 2005 editorial, you compared life expectancy at birth in the US in 1900 and 1998. I think this is a little misleading. A better comparison would be life expectancy at age 50. It has hardly changed at all in the last 100 years. If you walk around an old cemetery, what you usually find is a lot of old stones saying baby so and so and then a lot of stones for people who died in their seventies, eighties, and nineties. People aren't living longer; they're just not dying young as much anymore.

Robert J. Otto

Dear Dr. Schmidt:

I've always been interested in nutrition as one of the main roads to good health. I think your March 2005 editorial was right on the mark. However, it didn't go all the way. Some time ago, perhaps as long as a year, there was a news article on TV. I'm sorry I didn't

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take down the details, such as who was doing the research or where they were working, but I think the program I saw was on CBS. Anyway, they were researching the nutritional needs of specific genes. Their conclusion was that to have optimum health, one had to "feed their genes." Of course, at this point in time, we can't do that, since very few of us have had genetic analysis, but I really think this is the way of the future. I know for myself, I really can't handle the foods recommended in most of the "fad" diets, but Atkins works well for me. I know many others who are the exact opposite, so obviously something is different at a very basic level. If people took note of what foods agree with them and what don't, they'd get a handle on what their genes need even without the analysis. In short, I think that "down under the noise," the signal is that each of us is different and there is no single diet for everyone.

Respectfully submitted,
Peggy Zanin

Dear Stan,

Near the end of your March 2005 editorial, you say, "American medicine as a whole is doing something impressively right." I could agree with you if you said American public health is making a real impact, rather than giving so much credit to the medical profession. The major positive impact on childhood death was the work of Dr. Semmelweis in the nineteenth century. Clean water, untainted food, and an effective sewage system have had far more impact on longevity than the medical profession. I would believe the medics more if I saw them working on the alphabet soup of so-called diseases of children by looking at the witches brew in modern junk food. And by junk food, I don't mean chocolate, ice cream, *et al*—I mean the packaged "junk" that will probably be around to mystify archeologists a thou-

sand years down the road.

Modern doctors have enough ego problems—don't add to them!

E. Hohol

Dear *Analog*,

John G. Cramer writes that the "phantom energy" scenario which allows an expanding universe to have a rapidly expanding net energy violates the "dominant energy" condition of general relativity, which helps rule out "some manipulations of general relativity that would permit things like wormholes, warp drives, and time machines."

May one infer that if "phantom energy" turns out to be legitimate, wormholes, warp drives and time machines may turn out not to be forbidden after all? This has obvious implications not only for physics, but also for SF, which has routinely exploited such ideas, despite deep skepticism among theoretical physicists.

For that matter, "phantom energy" itself has obvious applications. If it exists and is, as Dr. Cramer suggests, "supplied from some phantom source 'outside' the universe," it represents a possible energy source for human use. The calculated values for "dark energy" given in Cramer's article are admittedly far too small to be useful—but what if this represents only the energy that spontaneously "leaks through" from the "phantom source"? In that case, it might be possible to devise means of drawing forth much greater quantities of energy. At the least, unless and until this is ruled out, it seems to offer some intriguing story possibilities. And of course, if it is not ruled out, it may offer a great deal more.

Eric B. Lipps
Staten Island, NY ■

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UPCOMING EVENTS Anthony Lewis

1-3 July 2005

CONVERGENCE 2005 (Minnesota SF conference) at Sheraton South, Bloomington MN. Guests include: Mercedes Lackey, Marv Wolfman. Registration: \$40 until 15 May 2005, \$55 at the door. Info: info@convergence-con.org; www.convergence-con.org; CONvergence, 1437 Marshall Ave., Suite 203, St. Paul MN 55104; (651) 647-3487.

1-4 July 2005

GAYLAXICON 2005 (SF conference for gay fans and their friends) at Hyatt Regency Cambridge, Cambridge MA. Guest of Honor: Lois McMaster Bujold. Fan Guests of Honor: Cast & crew of Star Trek: Hidden Frontier. Registration: \$50 to 31 May 2005, more at the door. Info: gsfs@gaylactic-network.org; www.gaylaxians.org/gaylaxicon2005; Gaylaxicon 2005, Box 1059, Boston MA 02103-1059.

1-4 July 2005

WESTERCON 58: "DUE NORTH" (Western Science Fantasy Conference) at Westin Calgary Hotel, Calgary, Alberta, Canada. Author Guest of Honor: S.M. Stirling. Canadian Author Guest of Honor: Dave Duncan. Artist Guest of Honor: Mark Ferrari. Fan Guests of Honor: Cliff Samuels, Eileen Capes. Publisher Guest of Honor: Tom Doherty. Editor Guest of Honor: David Hartwell. Science Guest: Phil Currie. Registration: USD65/CAD80 until 15 March 2005. Info: info@calgaryin2005.org; <http://calgaryin2005.org>; Calgary in 2005, Box 43078; DVPO, Calgary, Alberta T2J 7A7, Canada.

8-10 July 2005

READERCON 16 (literary-oriented SF conference) at Burlington Marriott, Burlington MA. Guests of Honor: Kate Wilhelm, Joe Haldeman. Registration: \$35 until 1 July 2005, \$45 at door. Info: info@readercon.org; www.readercon.org; Readercon, Box 38-1246, Cambridge MA 02238-1246.

15-17 July 2005

CONFLUENCE 2005 (Pittsburgh area SF conference) at Four Points by Sheraton Pittsburgh Airport, Pittsburgh PA. Guest of Honor: Tamora Pierce. Featured Filker: Escape Key. Registration: \$40. Info: confluence@spellcaster.org; www.parsec-sff.org/confluence; Confluence Box 3681, Pittsburgh PA 15230-3681; (412) 344-0456.

15-17 July 2005

TRINOCOON 2005 (Carolinas SF conference) at Durham Marriott and Civic Center, Durham NC. Literary Guest of Honor: Joe R. Lansdale. Artist Guest of Honor: Charles Keegan. Registration: \$30 until 18 June 2005, \$35 at the door. Info: info@trinoc-con.org; www.trinoccon.org; TrinoccoN Corp., Box 10633, Raleigh NC 27605-0633.

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